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# REVIEW OF ARMS CONTROL AND DISARMAMENT ACTIVITIES
## 99th CONGRESS, 1st SESSION

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## HEARINGS

BEFORE THE

SPECIAL PANEL ON ARMS CONTROL AND DISARMAMENT

OF THE

PROCUREMENT AND MILITARY NUCLEAR SYSTEMS SUBCOMMITTEE

OF THE

COMMITTEE ON ARMED SERVICES
HOUSE OF REPRESENTATIVES

NINETY-NINTH CONGRESS

FIRST SESSION

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SEPTEMBER 10, 12, 18, 20; OCTOBER 31;
NOVEMBER 20; DECEMBER 12, 1985

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## Special Panel on Arms Control and Disarmament of the Procurement and Military Nuclear Systems Subcommittee

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# MUTUAL AND BALANCED FORCE REDUCTIONS [MBFR] NEGOTIATIONS AND THE NUCLEAR NONPROLIFERATION TREATY [NPT]

House of Representatives, Committee on Armed Services, Special Panel on Arms Control and Disarmament of the Procurement and Military Nuclear Systems Subcommittee,
*Washington, DC, Tuesday, September 10, 1985.*

The special panel met, pursuant to call, at 10:15 a.m., in room 2212, Rayburn House Office Building, Hon. Beverly Byron (chairman of the special panel) presiding.

## OPENING STATEMENT OF HON. BEVERLY B. BYRON, A REPRESENTATIVE FROM MARYLAND, CHAIRMAN, SPECIAL PANEL ON ARMS CONTROL AND DISARMAMENT OF THE PROCUREMENT AND MILITARY NUCLEAR SYSTEMS SUBCOMMITTEE

Mrs. Byron. First of all, I would like to say that the Committee on Armed Services has an important oversight responsibility in the areas of arms control and disarmament. Since the Subcommittee on Procurement and Military Nuclear Systems is responsible for authorizing appropriations for weapons of all types and the operation of the Department of Energy national security programs, arms control matters have been assigned to that subcommittee.

As has been the practice in prior years, Chairman Stratton has reappointed this special panel to assist the subcommittee in its arms control oversight functions.

The jurisdiction of the Armed Services Committee over arms control matters is based on the obvious fact that our military force structure cannot be separated from our national security policy; nor can our national security policy be separated from our foreign policy. It follows that our arms control policy must support, and not be in conflict with or unreasonably restrict the achievement of our military force structure requirements, including force modernization, readiness and mobility. Where conflicts have occurred in the past, arms control alternatives have been foreclosed and existing arms control treaties have gone down the drain.

I hope that the series of hearings that begin today will serve several purposes:

First, to update our information from U.S. negotiators on the several sets of negotiations that have taken place in Geneva and in Vienna earlier this year. Of particular interest will be progress reports on the nuclear and space arms control and chemical weapons ban negotiations in Geneva. We will also receive a briefing on the

Nuclear Nonproliferation Treaty [NPT] 5-year review conference and a progress report on the Mutual and Balanced Force Reductions [MBFR] negotiations in Vienna.

Second, I would hope that the witnesses from the U.S. Arms Control and Disarmament Agency [ACDA] and from the State Department will address several issues and help us to put them into context. These issues include reported Soviet offers to reduce strategic arms; to abide by an unnegotiated moratorium on nuclear testing; to abide by a similar moratorium on ASAT testing and research; and other Soviet "offers." Although these issues have been raised by the Soviets in the U.S. news media, it is not clear that they are included in various Soviet negotiating positions.

Third, it appears that the notion of a comprehensive test ban [CTB] possibly achieved through negotiations, through an informal moratorium, or through proposed legislated restrictions on defense expenditures, is again becoming fashionable. The prospect of a CTB, its probable effects on our deterrent forces and their modernization, and the risks involved have been raised by H.J. Res. 3 and H.R. 3100. These hearings should provide the panel with a better understanding of the issues involved in those measures.

Our first witness today will be Ambassador Robert Blackwill who is the U.S. Representative to the Mutual and Balanced Force Reductions [MBFR] Negotiations in Vienna.

This afternoon we will hear from Ambassador Donald Lowitz who is the U.S. Ambassador to the 40-nation U.N. Conference on Disarmament in Geneva. In addition, we will receive an intelligence briefing from Dr. Robert Barker of the Bureau of Verification and Intelligence in the U.S. Arms Control and Disarmament Agency.

I want to welcome Ambassador Blackwill on behalf of the panel. The panel will proceed in open session until such time as it may be necessary to go into closed session for national security reasons.

Ambassador, once again I apologize for starting the hearings a little late, but I think we are ready to go now.

With that, I would like to ask Mrs. Holt if she has a statement.

## STATEMENT OF HON. MARJORIE S. HOLT, A REPRESENTATIVE FROM MARYLAND, RANKING MINORITY MEMBER, SPECIAL PANEL ON ARMS CONTROL AND DISARMAMENT OF THE PROCUREMENT AND MILITARY NUCLEAR SYSTEMS SUBCOMMITTEE

Mrs. HOLT. Thank you, Madam Chairman.

I apologize for being late myself. I want to join you in welcoming our distinguished witnesses today, and I certainly look forward to the briefings that would be offered during this week and next week.

I believe that there is no doubt that every member of this panel, and perhaps everyone in this room, firmly believes in the basic purposes of arms control as those purposes have been so clearly set out in the Arms Control and Disarmament Act of 1961. I am concerned, however, that the historical purposes of arms control have been taking a back seat to an undefined entity called the "arms control process."

The Arms Control and Disarmament Act clearly recognizes that arms control has its limitations; that its purpose is to enhance national security; and that arms control cannot endure where one party can take advantage of the military weaknesses of other parties.

I am really concerned that some of those who are enamored with the "arms control process"—as opposed to arms control—are driving down a strange and dark road at a speed that exceeds the range of their headlights. I refer to those who demand immediate negotiations on a number of vital military issues; who demand agreements apparently for the sake of agreements, and there are those who would enforce their arms control demands through legislation freezing or destroying vital defense activities. In my opinion, those who would pursue this type of "arms control process," are not seeking true arms control. The result will be something quite different.

Our negotiators are engaged in what promises to be very long and complicated negotiations on a variety of subjects vital to our national security. I believe that they deserve the support of this panel, of the committee, and of the Congress and that we should give them a chance to arrive at the best agreements possible. The strong support of Congress will strengthen their hands in these difficult negotiations and will result in agreements in the best interests of the United States, if agreements are to be reached at all.

Thank you for the opportunity to express my concerns.

Mrs. **Byron**. Thank you.

Mr. Ambassador, you may proceed.

## STATEMENT OF AMBASSADOR ROBERT BLACKWILL, U.S. REPRESENTATIVE TO THE MUTUAL AND BALANCED FORCE REDUCTIONS [MBFR] NEGOTIATIONS

Ambassador **Blackwill**. I understand that I am the first of a number of administration officials who will be speaking with you about arms control matters this week and next, and I just want to say that I am sure I speak for all of them in expressing our desire to make this a fruitful exchange of views profiting both ourselves and the panel.

I would now like to read my statement.

Mrs. **Byron**. Thank you.

Ambassador **Blackwill**. Madam Chairman, distinguished members of the panel, I am pleased to be here this morning to discuss the Vienna Mutual and Balanced Force Reductions [MBFR] negotiations with you. I will keep my introductory remarks brief so that we can pursue issues of particular interest to you.

As you are aware, the MBFR negotiations have been going on now for nearly a dozen years. While the 19 countries involved have reached accord in principle on some key points, the talks to date have not produced agreement on how to proceed to reductions of NATO and Warsaw Pact forces in a way that meets the interests of both sides—particularly, from our vantage, western security interests.

## FACTORS CONTRIBUTING TO LACK OF RESULTS

A variety of factors have contributed to the lack of substantive results. A basic issue, of course, is the matter of Soviet interest—or, conversely, the lack thereof—in actually reducing its military presence in Poland, Czechoslovakia and the German Democratic Republic, as well as in reducing the Warsaw Pact's conventional superiority vis-a-vis NATO in Central Europe.

Setting aside for the moment this central question of Soviet motivations, there are at least three other fundamental factors which contribute to making these negotiations difficult.

First, there is the matter of geography. A glance at the map quickly demonstrates how the East's geographic situation—with the Soviet Union directly adjacent to, but outside, the reductions area—confers on the Warsaw Pact significant advantages for introducing reinforcements quickly into Central Europe. In contrast, U.S. troops are an ocean away.

We must be sure that any MBFR agreement does not shift the military balance even more in the East's favor. Thus, NATO has to carefully weigh the impact of geography in assessing the specific terms of any MBFR proposal—and in so doing, to recognize that geography intrinsically favors the other side in the NATO/Warsaw Pact security equation.

Second, there is the matter of the existing imbalance of conventional forces in Central Europe itself. According to Western estimates, the Warsaw Pact has over 200,000 more ground and air force personnel in the MBFR reductions area than does NATO. Achieving the Western goal of parity at lower manpower levels, which by definition requires that the East take significantly greater reductions than the West, runs into obvious difficulties, particularly as the East claims that a balance of forces already exists in Central Europe.

Third, there is the matter of the secretive nature of the Soviet system. The Eastern penchant for excessive secrecy—particularly with regard to military matters—places a formidable obstacle in the way to the necessary degree of clarity required for an effective agreement. These factors weigh heavily on the MBFR negotiations and are at the root of the two chief issues which have dominated the talks.

The first is the data issue. In brief, the sides disagree on the number of Warsaw Pact forces in the reductions area, with a discrepancy of approximately 20 percent between Eastern and Western figures. Our estimates indicate, for example, some 970,000 Warsaw Pact ground forces in the reductions area.

The Soviets and their allies, however, claim that the number is approximately 800,000. The deadlock on the data issue is longstanding, going back a decade at least. The import of the data issue goes beyond its implication of asymmetrical Eastern reductions if true parity is to be achieved, as both sides have agreed. There are also serious political questions which go to the very heart of the arms control process and raise doubts about Eastern intentions, as do documented Soviet violations of existing arms control agreements in other contexts.

The second major issue is verification. By and large the East insists—as it does in other arms control fora—that national technical means are sufficient to verify an MBFR agreement and has resisted such measures of verification as on-site inspection.

### CURRENT STATE OF PLAY

The current Western proposal in Vienna calls for a single, comprehensive treaty, to be preceded by prior agreement between the two sides on the number of all ground combat and combat support forces in the area of reductions. The West is willing to set aside initially the issue of ground combat service support forces and air force personnel, where we believe much of the East-West data discrepancy may exist.

The proposal, which was originally tabled in 1982 and modified in April of last year, also calls for staged reductions—i.e., beginning with United States and Soviet reductions, followed by those of the other MBFR participants—to eventual common ceilings of 700,000 ground forces and 900,000 combined ground and air force personnel for each side in the reductions area.

The Western proposal also contains a set of interrelated "associated measures," so-called, including provisions for on-site inspection, which are aimed at strengthening confidence and stability, without unduly restricting normal peacetime activities.

The current Eastern position is based on a proposal tabled by the Warsaw Pact in February of this year. It calls for a limited, initial agreement focusing on United States and Soviet reductions only and a freeze on the forces of both alliances, deferring negotiations on further reductions. The proposal for Soviet reductions of 20,000 troops in return for United States reductions of 13,000 falls 10,000 Soviet troops short of the NATO position on initial United States-Soviet reductions. Moreover, the provision for a general freeze would contractualize the existing conventional military imbalance, and provide a disincentive for the Warsaw Pact to negotiate seriously any further reductions.

The latest Eastern position also demands reductions and a freeze on armaments, a move I believe clearly is aimed at derailing NATO conventional modernization efforts. The February Eastern proposal, however, makes no move to meet Western verification requirements and, indeed, arguably represents a hardening of the Eastern position.

The East's proposed freeze, for example, would be without numbers and would be verified by a combination of national technical means and what they call "political goodwill." As for the data issue, the East proposes to "resolve" this problem simply by dismissing it entirely.

I should stress that our NATO allies attach great political and military importance to MBFR. It is the one East-West arms control forum in which they are able to participate actively. As are our allies, the Reagan administration is currently concluding a review of the Vienna negotiations and how to conduct them in the months ahead. No conclusions have yet been reached and we will be consulting and coordinating closely with our NATO friends.

## CONCLUSION

In sum, the prospects for progress in the near term in the negotiations are not especially encouraging. Resolution of the two key issues—data and verification—does not seem to be on the immediate horizon. The factors of geography, conventional imbalance, and Soviet secrecy continue to complicate our efforts aimed at reaching an effective and sound agreement.

At the same time, however, alliance unity continues to hold strong, and the NATO countries remain committed to achieving an agreement which corresponds to Western security requirements and interests. As my friend, Ambassador Kampelman, has indicated, the essence of arms control negotiations is that we must be prepared to sit at the table 1 day longer than the other side.

Finally, I would like to say how delighted I am that members from this panel will be visiting the MBFR negotiations in Vienna later this month at the beginning of the next round. I look forward to continuing our discussion of the MBFR talks there.

Mrs. BYRON. Thank you, Ambassador.

Let me go into a couple of questions I have. I think we can do them in open session. We may have to go into closed session. We just lost our quorum, so bear with me for a few minutes.

As you said, you talked a little bit on page 6 about the most recent Soviet/Warsaw Pact proposals. Do you find going back over the history of the MBFR that there are any new breakthroughs or any differences in those proposals than the ones that we have seen in the past? I know we consistently are concerned and one of the high priorities we have is verification. They have come back consistently without having an answer to verification and just ignoring the fact that it is a very serious stumbling block, but with examination of their new proposals this year in the last series of discussions, do you find that there are any changes in there at all or any softening?

Ambassador BLACKWILL. I think the simple answer is no. The Soviet proposal is really an aggregation of ideas they have had in the course of the negotiation; that is to say, that we should have a freeze on NATO forces and on Soviet and Eastern European forces with no data and obviously it is very difficult to verify whether someone is violating a ceiling if you don't have an agreement on what the ceiling is.

## VERIFICATION

On verification, I think it is true to say that in the 12 years of negotiation they have made a few very modest steps forward, but compared to what is required to verify any MBFR agreement, they are far from what is necessary.

An example, but perhaps it will make it somewhat more vivid, the NATO position is that one must have entry-exit forums to watch the forces meant to leave the area and make sure that they don't come back into the area.

The Soviet proposal is that those observers would arrive a few days before the forces were meant to leave. They would watch them leave and then the observers themselves would leave. I said to my Soviet counterpart, "Do I have this straight? What would happen is that you all could march out with bands playing on Tuesday and then the observers would leave and you could march back in with bands playing on Thursday."

I think that shows that they have a considerable way to go before they will meet the requirements that we must have in order to verify any MBFR agreement.

Mrs. **Byron**. Looking at their proposals, have we had changes in the proposals? You say that the NATO Alliance puts a great importance on these talks, probably a higher importance than on some other series that are going on in Geneva. Do you see in any respect something changing on that side?

Ambassador **Blackwill**. Well, in 1984 in order to address this problem of data in which we are persuaded that they have well over 200,000 more forces in the area than they admit they have and we are confident that our figures are very close to being accurate that they are simply misrepresenting how many forces they have, in 1984 we said to them, a good deal of this disparity may be in the service support forces, not in the combat support forces, transportation, medical, that sort of thing, communications and, therefore, let's put those aside for data agreement purposes, let's put the air force aside for data agreement purposes and see if we can reach an agreement on the ground combat forces of NATO and the Warsaw Pact in order to show some flexibility on the data issue.

They were as opposed to that proposition as to any other we put forward and their assertion now for more than 5 years has been that they will not discuss data, that their data is on the table, that it is accurate data, that it is the West that is misrepresenting the data for political purposes and they will not discuss it.

We have said to them without a resolution of the data issue which is a requirement in order to verify any agreement, we simply wouldn't sign any treaty.

Mrs. **Byron**. Do any of our sources give us an understanding or an idea whether we have had an increase or a decrease or has the number of forces remained fairly constant?

Ambassador **Blackwill**. The Warsaw Pact forces within the area of reductions have been fairly stable.

Mrs. **Byron**. In other words, there has been no movement toward a reduction in number because of any potential results of the talks that are currently going on?

Ambassador **Blackwill**. No, quite the contrary. As a matter of fact I alluded to this at the outset. One of the fundamental questions about Soviet intentions is related to your point. It is that one has to ask whether they really want an agreement given their security requirements for maintaining their empire in Eastern Europe. We have to go on pushing them, I believe, in order to try to reach an equitable solution to this problem, but I think there is a real question about whether they want an agreement and whether their perception of their security requirements to allow them to take the sort of reductions that would be necessary in order to reach an agreement.

Mrs. **Byron**. Just to end a series of thoughts on this initially with one question, and that is I have always advocated talking. As long as you are talking, you are making some kind of progress. If you are not talking, you are not making any progress at all. And yet, looking over the history of the 12 years of this series of talks and the importance that the NATO allies put on it, do you think we should continue?

Ambassador **Blackwill**. I think that is a fair question. After 12 years, I think it comes across all our minds, including the American negotiator at the talks and across my mind, when the possibility of this job first came up, I think the answer is yes, for several reasons. The first reason, and I think the most important one, is that this is the most heavily militarized piece of real estate on the face of the Earth, 2 million men under arms, and I think we have to go on working on that problem. It is obviously a tough problem and one that doesn't lend itself to easy resolution, but it seems to me sufficiently important that we have to go on chewing on the piece of meat no matter how tough it is.

Second, our allies care a great deal about this negotiation. It is the only NATO-Warsaw Pact negotiation, the only negotiation in which they take part as equal partners in the arms control effort. In that sense, it is quite different in Geneva, which is a bilateral United States-Soviet negotiation, which they are interested in, but not direct participants in, so I think we should continue for that reason.

I believe it is important to go on talking with the East about these issues. I am skeptical that anything fundamental is going to change on their part, but I think we have to keep expressing our security concerns to them and that it is in our interest to do so.

Mrs. **Byron**. One further question. I think the important aspect that you have to look at is the caliber of the individuals that the Warsaw Pact nations have representing them at these talks. We had a period of time when the caliber of the Russian Ambassador and several of the other nations were not of their highest top people. Has that changed somewhat or are we still dealing with people that are sort of down on the pecking order, so to speak?

Ambassador **Blackwill**. Well, first of all, we don't know a great deal about how Soviet defense policy is made, all too little I fear, and I can't speak very definitively about the influence of my Soviet colleague when he goes home. I can say he has been there for over 4 years. He knows the negotiation inside out. He is an able man and I think that is generally true of the other Eastern representatives as well. They are tenacious bargainers who represent their country's position very adroitly and I just hope we do as well.

Mrs. **Byron**. Mrs. Holt.

Mrs. **Holt**. Thank you, Madam Chairman.

I have some concern about verification. I think that is the bottom line on any negotiations. We certainly have not made progress with the Soviets in trying to have verification. I remember talking with Marshal Ogarkov several years ago asking him why they wouldn't agree. He said you have the means, your national technical means give you all the information. We know what you are doing and you know what we are doing. How do we square that with our claiming their 200,000 additional people? What do they say when we claim that the data is 200,000 more and they say, "Well, you are wrong on that." Do they ever agree that our verification methods are not good or why can't we get our data correct?

## VERIFICATION

Ambassador **Blackwill.** First of all, they don't really quarrel with our figures. They simply say they are wrong, but not in any disaggregated way. An example, I was having a chat with my Soviet colleague and I said to him, "Every single independent research institution who looks at these matters in the West, whatever their ideological view, left, right, or center, has concluded that the Warsaw Pact has a significant conventional advantage in this area in Central Europe, including manpower."

I was saying that to try to buttress our arguments that they have many more people in Eastern Europe than they admit. He said, "I can quote one source which says quite the contrary." I said, "What is that?" He said, "The Soviet Ministry of Defense." I observed that that, in my view, wasn't a terribly independent source, but in any event, their position is that we have invented this more than 200,000-man disparity in order to sabotage the talks, and we haven't been able to shake them.

On the more general question of verification, I think you are right, it is the heart of the matter, because we have to be sure that any treaty we sign, that we can verify that the Soviet Union is adhering to its terms. I think we have to do that for several reasons, not least because if we sign any treaty which is weak on verification it will affect our capacity to sign other treaties.

So I think we have to be strong across the board and particularly in this negotiation I think it is important, but so far we haven't been able to shake the Soviets on that matter.

The final point is—and I refer to it in my statement—they can continue to say that all the problems of this negotiation can be solved if there is only sufficient political goodwill, and I have observed to them that a casual reader of the newspaper would seem to conclude that there is not a great deal of political goodwill between our two countries at the moment and it is beyond me why they imagine this is going to turn the trick.

But all this is a means to try to persuade us not so much in Vienna, but in our public opinion to put aside the fundamental problems of this negotiation and sign a freeze so that they would freeze their advantages in the area.

Mrs. **Holt.** I certainly agree with you and with our chairman that talking is better than not talking, and I can see the advantage in having our allies involved in this negotiation, but sometimes I wonder what is in it for us? You know, they have such a geographic advantage over us, the Warsaw Pact countries, they could move forces much quicker than NATO could—I don't know exactly why we have arrived at the number that we have. Why not more, why not less, and wouldn't our NATO allies get in a real scrap about where the reduction was going to come, who is going to cut back?

They are all wanting to cut their defense budgets and so it seems to me that that would be a point of concern with them, and also what would we do with our forces? We really wouldn't have any place to bring them back to the United States and so it would mean a decrease in our military.

So I don't really see what we are aiming for except just to be talking for talking's sake. Do you have thoughts on that?

Ambassador **Blackwill**. I think those are very good questions and ones which people who are serious about the negotiation have to keep asking them to be sure they are not mindlessly going down a road established before without looking at fundamental issues. It has been the view of successive American administrations, including this one, that an MBFR agreement along the lines that I have described would be in the United States' interest and in NATO's interest.

There are several reasons for that. First of all, the kind of Soviet troop withdrawal that would be required would force them to reintroduce those forces into the central region in times of crisis which would give us more early warning and reduce the likelihood of surprise attack.

Second, in Europe this negotiation has had the advantage of forestalling unilateral troop reductions and there are always forces within European parliaments who would like to see us unilaterally disarm.

Our friends have been able to argue as long as we were negotiating with the East that wouldn't be sensible. The essential advantage of this agreement is that if we could reach such an agreement, it would increase our capacity to first deter the Soviets in a conventional war in Europe and thus make a nuclear war in Europe less likely because most people who look at this carefully believe that a nuclear war would follow a conventional war, so obviously conventional deterrence is very important.

A last point related to the chairman's initial remarks about the importance of judging arms control by what our defense requirements are, which I wholeheartedly support. That is that we are going forward, under General Rogers' supervision, with an initiative, with a considerable defense modernization effort, and all of that effort would be perfectly consistent with any MBFR agreement we would sign. There is no doubt about that fact, either in the United States or in the administration—and I discussed this at length with the Joint Chiefs last week—or in the Alliance. There is consensus that nothing in MBFR must inhibit our capacity to improve conventional defense.

Mrs. **Holt**. Thank you.

Mrs. **Byron**. Mr. Ray.

Mr. **Ray**. Good to have you here this morning. This morning I noted on the news that Mr. Gorbachev had advocated a zone free of chemical weapons in Europe. Are you familiar with that?

### CHEMICAL-FREE ZONE IN EUROPE

Ambassador **Blackwill**. That is a long time Soviet propaganda ploy. I didn't hear the morning news. I was still in mourning after last night's game, so I probably wasn't listening to the news as carefully as I might have been. But the Soviet proposition that we should have an unverifiable chemical weapons zone in Europe has been there a long time.

Mr. **Ray**. Do you know the boundaries of such——

Ambassador **Blackwill**. I am not sure what he said this morning, but traditionally they have been interested in a zone which would be the two Germanys, as broad as possible from their point of view, because they introduce no verification measures which would allow us to know whether they were keeping chemicals or not.

They would be sure that because of our public opinion and press we would adhere to a chemical weapons ban, and they would not. That is the purpose of that proposition. We have a global chemical weapons ban proposal on the table which they have continually rejected because of its verification provisions.

They would like to have a regime in which they are allowed to possess a chemical weapons capacity and we are not.

Mr. **Ray**. Do you think the fact that he has raised the subject is due to the fact that the Congress has passed the binary chemical legislation that we have? Do you think that might have brought this back to light?

Ambassador **Blackwill**. I think there is no doubt of that. The Soviets have watched for years the discussions between the executive branch and the Congress about binaries, and have done everything they could to reduce the American peoples' willingness to proceed in this way. And I think they are worried about it because they have a chemical warfare [CW] advantage in Europe and want to retain it.

As you know, the Soviet Union treats chemical weapons in the way they treat ordinary weapons, and they have a combined arms attack philosophy. It is not a special weapon system for them, and they would obviously like to keep their advantage because they think some day they might use them.

Mr. **Ray**. You mentioned that your counterpart had 4 years of experience. What is his name?

Ambassador **Blackwill**. His name is Mikhailov.

Mr. **Ray**. How long have you been there?

Ambassador **Blackwill**. I am a Foreign Service career officer, and have worked on arms control issues for the last 10 or 12 years of my career. I served in Kenya and London, then served in Tel Aviv at our Embassy there during the Camp David negotiations.

More recently I served in the Politico-Military Affairs Bureau in the State Department.

Mr. **Ray**. You have just reported for duty in Vienna?

Ambassador **Blackwill**. Yes; the last 2 years I was on sabbatical leave at Harvard. I arrived there in May and have done one round.

Mr. **Ray**. It seems to me that we rotate our people around and about the time they get skilled and ready to go to work and the Soviets leave their people on hand waiting for our people to leave. I would think this might not be in our best interest to do that.

Do you know if any kind of new strategy is in place or being thought about that might be different from anything we have done today? It seems to me we are beginning to get into more of the issue, which is dialog and talking, which I advocate, but it does appear to me that we ought to have some sort of a new type innovation or strategy to hit with.

Ambassador **Blackwill**. Maybe it is only partly, because I grew up on a Kansas farm, but I am a little bit suspicious of overly inventive minds. And I think our fundamental approach to MBFR has been correct, consistent for 12 years, one that has been supported by our allies, and at least so far we believe that it was the appropriate one to follow.

We are now looking at the negotiations in the administration. We are in discussion with our allies about how we should conduct ourselves in Vienna and that will continue, but I would say one thing on that score. This is speculation, but I believe it to be the case. I think when the Soviets decided to join the MBFR negotiations in early 1973, they very much hoped that some of the possible definitions that Mrs. Holt had mentioned earlier would dominate the alliance discussions, and the Soviets could use MBFR to guide the alliance.

They have been disappointed if that indeed was their objective. I think one of the major benefits of this negotiation has been the solidarity that has characterized the negotiations on the Western side for these 12 years, and our capacity to discuss not just with the East, but with our allies the requirements for the defense of Central Europe. And I think there has been an educating process.

I don't mean to make it sound as if it is all one way either. I think NATO is much more aware of the Soviet today than it was 12 years ago. I think that our approach is fundamentally sound, and I would want to look very carefully at any new idea that might emerge.

Mr. **Ray**. Thank you.

Mrs. **Holt**. Will the gentleman yield?

Mr. **Ray**. Yes.

Mrs. **Holt**. I move that the Chairman be authorized to go into executive session for today and 5 additional consecutive days of hearings for the purpose of receiving classified information regarding national security.

Mrs. **Byron**. Call the roll.

Mr. **Klein**. Mrs. Byron.

Mrs. **Byron**. Aye.

Mr. **Klein**. Mrs. Holt.

Mrs. **Holt**. Aye.

Mr. **Klein**. Mr. Mavroules.

[No response.]

Mr. **Klein**. Mr. Badham.

[No response.]

Mr. **Klein**. Mr. Ray.

Mr. **Ray**. Aye.

Mr. **Klein**. Mr. Courter.

Mr. **Courter**. Aye.

Mr. **Klein**. Mr. Spratt.

[No response.]

Mr. **Klein**. Mr. Stratton.

Mr. **Stratton**. Aye.

Mr. **Ray**. That concludes my remarks.

Mrs. **Byron**. Mr. Courter.

Mr. **Courter**. Thank you.

There is a substantial disagreement, I gather, between the Soviet stated pronouncements as to the number of troops that they have, and our knowledge as to how many troops that they have. And that is a substantial difference of 200,000 or more.

Is there an agreement as to how many troops we have?

Ambassador **Blackwill**. Yes; and they have never quarreled with that. We put down data at the outset of the negotiation in 1973, and they have never quarreled with our numbers.

Mr. **Courter**. Do we have to go into closed session for you to describe what truth you proffered to the Soviet Union as to how we arrive at our numbers as to their force levels?

Ambassador **Blackwill**. Well, we would have to go into executive session if I were to describe to you how we aggregated these numbers, but we don't go into detail with the Soviets about how we do it for precisely the same reason that we would have to go into executive session to talk about it. That is to say it is a sources and methods question.

Mr. **Courter**. You say, look, we know you have so many, and that is it?

Ambassador **Blackwill**. We have tabled numbers for their forces, and we believe that they know that those numbers are more or less accurate. These numbers are consistent with independent research organizations' tabulations of their forces. And they have denied it.

Mr. **Courter**. You have been there a period of time, and I am sure you spoke to prior U.S. negotiators that have been negotiating this thing for 12 years. Has there ever been any informal cocktail hour wink of the eye from the Soviet side saying this is a merry-go-round and we know that you are right on our numbers?

Ambassador **Blackwill**. No.

Mr. **Courter**. I mean after a vodka or anything like that.

Ambassador **Blackwill**. No.

Mr. **Courter**. No break?

Ambassador **Blackwill**. No, at least not that I am aware of. They are very disciplined. Their society requires it.

Mr. **Courter**. It has been going on for 12 years. What do you do all day? I am up-to-date now on what has happened. I am very curious what happens for another 3 months or something after 12 years, and the Soviets say that is so many troops we have. Do you say, no, you don't. You have that many?

It seems that could be said in 30 seconds.

Ambassador **Blackwill**. The diplomat's task is to say in an hour what others could say in 30 seconds. You may be on to something here. I could tell you what happens in an ordinary week. There is, for those of you who can come to Vienna, I will try to make sure you see as much of this as possible.

There is a plenary session in which one side or the other reads a plenary statement. It is like a United Nations speech. There is no give and take. One side reads a statement, and it takes one element of their position and describes it, and it is quite repetitive as you suggested. But in addition, there are other meetings, formal and informal with the Eastern colleagues in which we continue to argue our point of view with them, and they continue to argue their point of view with us.

Finally, a major part of my time and that of my allied counterparts is taken up with discussions among ourselves. Not to become too technical and pedantic here, but this negotiation is unusual because our instructions come from the NATO Council. My instructions don't come from the President. They come from the NATO

Council. Basically, whatever we say to the other side has to be approved by all the NATO participants in this negotiation, and that means that we have a mini NATO, which is happening in Vienna. And it takes a lot of time.

I would like to say a last thing about patience. I remember reading a poem once which characterized Mother Russia as the seat of patience. They are an extraordinarily patient people. Their constant refrain in Vienna is why don't you think of something different, because what you are suggesting obviously won't work.

I think it is our task to continue to try to persuade them that what we have suggested is sensible; is in both side's interest, and that they should try to reconsider it. It has been going on 12 years. There are obviously some fundamental problems, and we stick by our principles which we certainly should. Then there are obviously great hurdles to overcome in this negotiation on the part of the other side.

We have a fair, equitable position, and have had for years, and I think we should abide by it. In arms control, one of the dangers is that one does become bored or impatient, and I really do believe that on the Western side. And this has certainly been the case, I think, for more than a decade that we have had patience, have stuck to our central principles, and have to continue doing it.

But they are very good at that, and we have to be just as good, and 1 day longer as Max Kampleman suggested. If they believe that we will tire with this negotiation and begin to become inventive and creative, they will wait for that moment to arrive, and we have to persuade them it isn't going to arrive. And they will have to negotiate in a way which produces equity, not unilateral advantage, which has been one way to sum up their position since 1973.

Mr. **Courter**. Thank you.

Mrs. **Byron**. Mrs. Holt, see how nice I am? I have a few.

Mrs. **Holt**. All right.

Mrs. **Byron**. Let me touch on a couple of things. Are there any existing treaties governing currently our relationships between NATO and the Warsaw Pact on troop strengths?

Ambassador **Blackwill**. No.

Mrs. **Byron**. None whatsoever?

Ambassador **Blackwill**. None whatsoever, and that has been the purpose of this negotiation.

Mrs. **Byron**. You also mentioned that the 19 countries had involved and actually agreed on a few key points. Could you discuss those key points that they have where both sides have made some progress?

Ambassador **Blackwill**. Well, yes, but you have to underline few here. One always looks——

Mrs. **Byron**. In red.

Ambassador **Blackwill**. In red, exactly. First of all, the two sides have agreed that the goal is a common ceiling on manpower and including ground forces and air forces of 700,000-900,000, 700,000 for ground forces and 900,000 for ground and air. That is the good news.

The bad news is that they are nowhere near agreeing on how many forces are actually there now, but they have agreed on that. They have also agreed that in the sequence of reductions, the

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United States and the Soviets should withdraw first, followed by other reductions of the other NATO-Warsaw Pact countries.

They have agreed that the form of reduction should be in manpower, and finally, the Soviets, as I suggested to Mrs. Holt earlier, have agreed to some very tepid, inadequate verification measures, but they are more than they agreed to at the beginning of the negotation, but there is still a very long way to go before we would reach a situation in which an agreement was on the immediate horizon.

Mrs. **Byron**. The other point that I wanted to touch on is in light of the recent killing of Major Nicolson. Is that going to hamper our intelligence gathering and insight on the Warsaw troop strengths by on-site inspections with a potential risk to our soldiers' lives?

Ambassador **Blackwill**. You can find more expert witnesses than myself to talk about the particular activities of our liaison teams, but I can say this—I thought this, in fact, the morning that I heard on "The Voice of America," that this horrifying incident happened.

I think it does display a fundamental characteristic of the Soviet system what happened there, which is easy resort to violence and a tremendous antipathy to openness, and most of those obviously have implications for the MBFR negotiations because a country which could be part of that murder, and particularly as a result after that murder, one has to wonder whether they ever will open themselves up sufficiently in order to have a verification regime that we could have some confidence would detect any violations.

That is especially true given their conduct in other arms control negotiations so the burden really is on them to show that they are willing to verify and to adopt measures which would allow us to verify these force levels. And I think one would have to be skeptical, given the whole nature of their society, that they will be willing to do so.

I think we have to go on trying to show not only the experts, but public opinion that this is the case, and why it is the case, and what it tells us about this form of government. And my NATO colleagues, in fact, believe that is very important, that this is a negotiation which does have some prominence in Europe, much more so than in the United States because it is the one that they participate in, and they argue to me, and I think there is a good deal to this, that this negotiation has shown the nature of the Soviet regime and has shown the difficulty in reaching agreement with them.

Mrs. **Byron**. I have no further questions.

Mr. Stratton, do you have any questions.

Mr. **Stratton**. No questions, Madam Chairman.

Mrs. **Byron**. Mrs. Holt.

Mrs. **Holt**. No questions.

Mrs. **Byron**. Mr. Klein, do you have any questions?

Mr. **Klein**. Thank you, Madam Chairman.

Mr. Ambassador, about 2 years ago this month General Rogers began, I believe, a big push to build up NATO, especially their conventional forces, urging the NATO governments to spend more money. I believe it was 4-percent-a-year increase instead of 3, and to substitute insofar as possible high technology and conventional weapons for nuclear weapons.

About 2 years ago next month, the Montebello Group met and decided to, over the next few years, remove another 1,400 nuclear weapons from Europe, which would make 2,400 weapons withdrawn since 1979. It appears that what General Rogers might want to do might be somewhat contradictory to the basic premises of what you are trying to accomplish in MBFR negotiations in that if there is, in fact, a buildup of high technology weapons, and these other things, they will have to be followed by a train of experts to service them, maintain them, operate them, such things as longer range aircraft, missiles of different types and the service people that go with them.

Does this sort of change the way that we are looking at the MBFR, or would it have a tendency to perhaps have the Russians or the Soviet negotiators take a harder look at any concessions that they might be willing to make?

### BUILDUP OF NATO FORCES

Ambassador **BLACKWILL.** Well, I think the simple answer is, no. The Supreme Allied Commander—and we have had several of them since the outset of this negotiation—and this strongly includes General Rodgers—has always supported MBFR for the reasons that I mentioned earlier in response to a question. And General Rodgers' view, which I believe is right, is that the MBFR proposal, which we have on the table, is consistent with his strenuous efforts to improve conventional defense, but I think you have pointed out an important issue, which is the armaments issue.

It is striking that the East has now in the negotiation mounted a renewed emphasis on limiting armaments, precisely the armaments that you were mentioning. And I have said to my Soviet colleagues that I see they read the "Herald Tribune," and know that we are interested in improving our conventional defense.

Our effort is precisely to improve conventional defense and armaments, which has led them to want a freeze on armaments, but we understand that, and we are not going to let that become a problem.

Mr. **KLEIN.** Have the basic tenets of MBFR changed since in the past 12 years? We have had considerable changes in Soviet airlift capability and their tactical aircraft. They have developed a sealift capability so that the forces within the central area may not be the primary forces that would include the defense of NATO.

The air power, for example, Soviet air power, might be the decisive thing rather than armor.

Ambassador **BLACKWILL.** Well, it has been a conviction of ours from the outset of this negotiation that aircraft just must not become limited in this negotiation because we depend so much on redeploying aircraft, as you know, from the United States and European contingencies to Central Europe.

But you are right to say that what we have to continue to do is ask ourselves that fundamental question as this massive Soviet effort to improve its conventional position in Europe from a position of superiority, to start with, continues. We have to review always our basic tenets to this negotiation and be sure that our position is consistent with safety and prudence and our defense.

Mr. **Klein**. Thank you, sir.

Mrs. **Byron**. Thank you very much, Mr. Ambassador. I appreciate very much you taking the time in your schedule to give us what I think is a good overview of where you see the first rounds of a very tedious series of discussions going. And I appreciate the time.

Ambassador **Blackwill**. Thank you for having me, and I look forward to seeing you in Vienna.

Mrs. **Byron**. The panel will adjourn until 2 o'clock.

[Whereupon, at 11:15 a.m., the panel was adjourned to reconvene at 2 p.m. the same day.]

## AFTERNOON SESSION

Mrs. **Byron**. Our first witness this afternoon is Ambassador Donald Lowitz, who is the U.S. Representative to the Conference on Disarmament in Geneva. The Conference on Disarmament, as described by the General Assembly of the United Nations, is the single multilateral disarmament negotiating forum of the international community. As such, the Conference plays an important role in the disarmament machinery available to the United Nations. For example, the agenda of the Conference on Disarmament for 1984 included such items as a nuclear test ban, chemical weapons, weapons in outer space, and new types of weapons of mass destruction.

I have asked Ambassador Lowitz to address the chemical weapons and nuclear test ban negotiations today in addition to other activities that are being carried out by the Conference on Disarmament.

Following the appearance of Ambassador Lowitz, Dr. Robert Barker, who is the Deputy Assistant Director of the Bureau of Verification and Intelligence of the U.S. Arms Control and Disarmament Agency, will present a briefing on verification requirements for agreements limiting the testing of nuclear weapons.

I note that both witnesses have unclassified prepared statements. Following the presentation of their unclassified statements, the witnesses will be given an opportunity to elaborate on their statements in closed session in accordance with the authority granted to the chair by the panel's vote this morning.

Ambassador, it is good to see you again and you may proceed.

## STATEMENT OF AMBASSADOR DONALD LOWITZ, U.S. REPRESENTATIVE TO THE U.N. CONFERENCE ON DISARMAMENT

Ambassador **Lowitz**. Thank you very much, Madam Chairman. I would like to introduce Dr. Pierce S. Corden, who is a member of my delegation on the Conference on Disarmament.

It is a pleasure to be here today, and I have submitted a prepared statement and would like to touch on the highlights of the statement at this point after which I will be pleased to answer your questions.

As you know, the Conference on Disarmament is the principal multilateral body that the international community has, and it has the objective of carrying out substantive work in the area of arms control and disarmament, in negotiating agreements affecting the international community as a whole. The Conference is the successor body to a number of predecessor organizations that began with the 18-Nation Disarmament Conference in 1962. The Conference, as its predecessors, operates on the basis of consensus, and this ensures that the United States and the other members can protect their essential interests. The membership of the Conference includes the militarily important states in the world, or most of them, and it includes for the first time all five of the nuclear weapon states: the United States, Soviet Union, United Kingdom, France, and China.

The United States is joined in the Western Group by a number of its NATO allies: Canada, United Kingdom, France, Federal Republic of Germany, England, and the Netherlands, as well as by Japan and Australia. The Soviet Union and other members of the Warsaw Pact nations belong to the Conference as well as Mongolia. There are 21 nonaligned states participating, ranging from Sweden to India, Pakistan, Brazil, Argentina, Mexico, and Egypt.

Each year the Conference begins its session and meets from February until May and again from June until September. Annually it determines its agenda and program of work, but basically these have not varied much over the past 7 years. We have added two new items to the agenda: the question of "The Prevention of Nuclear War, Including All Related Matters," and "Prevention of an Arms Race in Outer Space."

In addition, the Conference deals with the issues of nuclear test ban, nuclear disarmament, chemical weapons, radiological weapons, new types of weapons of mass destruction, negative assurances, and a comprehensive program of disarmament.

### CHEMICAL WEAPONS NEGOTIATIONS

At this time in my view and in the view of the administration, the most important issue facing the Conference on Disarmament is that of chemical weapons, and I think the objective of the administration is clear. It is our desire to negotiate promptly a comprehensive ban on chemical weapons as well as to make sure that we can prevent their further proliferation; and until a ban is in force, the question of proliferation is, of course, an important one.

The work of the Conference on chemical weapons is carried out primarily in a subsidiary body known as the Ad Hoc Committee on Chemical Weapons, and it is that body that is dealing now with the question of negotiating a convention. The United States introduced a proposed draft chemical weapons convention in April 1984 when Vice President Bush visited the Conference and presented the draft treaty on behalf of the United States.

This year the Conference committee has produced for the first time what is the beginning of a comprehensive text for a chemical weapons convention; and although this text contains many bracketed portions and some incomplete sections, it is the basis on which we will now continue our work next session.

In reviewing the chemical weapons negotiations during this past year, I think it is fair in my opinion to say that we have seen a modest amount of progress, although largely of a procedural character. It is regrettable to me and to my delegation that the negotiations continue to move much too slowly, and it is regrettable that the continuing spread and use of chemical weapons has not yet seemed to have imparted a greater sense of urgency to the Conference's work.

As I review this session's negotiation, it appears that immediately following the House vote to authorize the production of binary chemical weapons the Soviet Union reacted in a highly polemical fashion and for a few weeks adopted a stance of silent withdrawal from negotiations. Then I believe the Soviet Union assessed the situation and concluded that the United States resumption of chemical weapons production might well become a reality, and it was in their interest to participate in the negotiations rather than to remain silent. At this point they resumed negotiating and the modest progress that we achieved in the committee occurred largely in the closing weeks of this year's session with the active participation of the Soviet delegation. This seems to indicate that the prospect of U.S. resumption of chemical weapons production may provide some incentive to the Soviet Union to become serious about the chemical weapons convention.

I want to caution against making too much of the largely procedural progress made thus far this year. The comprehensive ban on chemical weapons we seek will be a complex agreement, as it must ensure destruction of chemical weapons stockpiles and that new stocks are not illegally produced in the peaceful chemical industry. Negotiation of such a ban is perforce a complex and lengthy undertaking. At present, on the most important substantive issues, verification in particular, there continues to be little agreement. While we search for mutually acceptable solutions, we continue to view as essential the need for mandatory, short-notice challenge inspection provisions—that would apply to any government-owned or controlled facility—and these would complement the more routine types of verification of such matters as destruction of stockpiles and the nonproduction of chemical weapons in the chemical industry.

On the other hand, we have made it clear in Geneva that it is the level of verification required to satisfy security concerns, and not necessarily our specific language, that is important in the negotiation.

My delegation often maintains very close contact with many other delegations in the Conference on chemical weapons, as well as other matters pending before the Conference. We have had a bilateral dialog on the chemical weapons issue with the Soviet Union delegation, and I would be pleased to expand on these discussions in a closed session.

### PREVENTION OF SPACE ARMS RACE

I would like to turn briefly to two other agenda items which have received a considerable degree of attention in the Conference. The first is that of the prevention of an arms race in outer space. Clearly, a primary focus on this important matter is the bilateral nuclear and space talks, which will resume again next week in

Geneva. However, we must recognize that many states have an interest in the outer space environment. This year, the Conference carried out an initial examination of outer space issues relevant in a multilateral arms control context. The United States fully participated in these activities, but thus far we do not see the possibility of identifying any particular subject as appropriate for beginning a multilateral negotiation.

A second item is that of a comprehensive nuclear test ban. We have made it clear in Geneva that our position continues to be that a complete cessation of nuclear explosions is a long-term objective of the United States. We have stressed that achievement of deep reductions in the nuclear arsenals of the Soviet Union and the United States is a more meaningful approach to nuclear arms control and should take precedence.

At the CD we have continued to support the need for substantive work on a range of test ban issues, including the scope of an eventual ban and verification of compliance. In particular, we have endorsed and supported with significant financial and technical resources the work of the group of experts in seismology and data processing that has been developing ways of exchanging seismic data on a global basis for verification of a comprehensive test ban.

In reviewing this past year's session, I believe on balance that the Conference had some modest success, particularly in the area of the chemical weapons negotiations. We attempted and I believe succeeded in making clear the United States positions on the issues dealt with in the CD and maintained unified positions with our allies.

As of now much of the focus of multilateral arms control efforts will shift to the United Nations General Assembly, where its First Committee, beginning in October, will take up and debate a wide variety of arms control issues.

I will be representing the United States in this work and I will be joined by a large number of my colleagues from the Conference on Disarmament in Geneva.

At this point I would be happy to answer your questions. Thank you.

## PREPARED STATEMENT OF AMBASSADOR DONALD LOWITZ

I am pleased to have the opportunity to appear before you today to discuss the activities of the United States in the Conference on Disarmament (CD). I was appointed United States Representative last December, and took up my duties in Geneva in January.

As you may recall—or in the case of those of you who have been to Geneva, as you know first hand--the Conference on Disarmament is the principal multilateral body of the international community with the objective of carrying out substantive work in the area of arms control and disarmament and negotiating agreements affecting that community as a whole.

The CD is the successor body to predecessor organizations dating back to the Eighteen Nation Disarmament Conference established in 1962. These bodies have been associated with negotiations leading to several important arms control treaties, including the 1963 Limited Test Ban, the 1968 Non-Proliferation Treaty, the 1971 Seabeds Convention, the 1972 Biological and Toxin Weapons Convention, and the 1976 Environmental Modification Convention. While the prior bodies operated under a United States and Soviet Union co-chairmanship arrangement, in 1978, following the First Special Session of the UN General Assembly devoted to disarmament, it was agreed that the new body, with an expanded membership of forty states, would operate with a chairmanship that rotated on a monthly basis. The

Conference, as did its predecessors, operates on the basis of consensus. This ensures that the United States, and the other members, can protect their essential interests.

The CD is not a United Nations entity, although the UN Secretary-General appoints a personal representative, who heads the CD's secretariat. The secretariat is also staffed by United Nations personnel. The CD also submits an annual report to the UN General Assembly.

The Conference includes most of the militarily important states in the world. For the first time, all five nuclear weapon states—the United States, the Soviet Union, the United Kingdom, France, and China—participate in a disarmament negotiating body. The United States is joined by many of its NATO allies—Canada, the United Kingdom, France, the Federal Republic of Germany, Italy, Belgium, and the Netherlands—as well as Japan and Australia. The Soviet Union has the other members of the Warsaw Pact and Mongolia as its allies. Twenty-one neutral or non-aligned states participate ranging from Sweden to India and Pakistan, Brazil and Argentina, Mexico and Egypt.

Each year the Conference meets from February to May and from June to September. It determines its agenda and program of work on an annual basis, but these have not varied much over the seven years that the Conference has met. Recently, two new items have been added to the agenda—the question of "The Prevention of Nuclear War, Including all Related Matters," and that of "The Prevention of an Arms Race in Outer Space." The other items include nuclear test ban, nuclear disarmament, chemical weapons, radiological weapons, new types of weapons of mass destruction, so-called negative security assurances, and a comprehensive program of disarmament.

Of the broad spectrum of items on its agenda, at the present time the one of most importance, in my view, is that of chemical weapons. The clear objectives of the Administration in this area are to negotiate promptly a comprehensive ban on these weapons that have such terrible effects, as well as to seek to prevent their further proliferation; and, so long as a comprehenisive ban is not in place, to maintain an adequate retaliatory capability to deter their use by the Soviet Union.

The work of the CD on chemical weapons is carried out largely in a subsidiary body—the Chemical Weapons Ad Hoc Committee—which has the task of developing a convention. As you know, the United States introduced a complete draft of such a convention when Vice President Bush appeared before the Conference in April 1984. At the urging of our delegation, the chemical weapons committee has now produced, for the first time, a comprehensive text—albeit one containing many bracketed portions and incomplete sections—which the Committee has agreed will serve as the basis of its further work.

In an effort to continue the chemical weapons negotiations on a timely basis, the Conference has agreed that informal consultations within the framwork of the Chemical Weapons Committee will be held this fall for three weeks, as well as a formal Committee session in January, before the CD begins its 1986 session in February.

In reviewing the chemical weapons negotiations this past year, I see a modest amount of progress, although largely of a procedural character. It is regrettable that the negotiations continue to move much too slowly. It is regrettable that the continuing spread and use of chemical weapons has not yet imparted a greater sense of urgency to the CD's work.

I mentioned the Administration's position concerning our need to maintain an adequate retalitory chemicals weapons capability to serve as a deterrent to the use of these weapons by the Soviet Union. In addition, as I review this session's negotiations, it appears that immediately following the House of Representatives vote to authorize the production of binary chemical weapons, the Soviet Union reacted in a polemical fashion and for a few weeks adopted a stance of silent withdrawal from active negotiations. Then I believe the Soviet Union assessed the situation and concluded that, since United States resumption of chemical weapons production might well become a reality, it was in their interest to participate in the negotiations rather than to remain silent. The Soviet delegation then resumed negotiating and the modest progress achieved in the Committee occurred largely in the closing weeks of this year's session with the active participation of the Soviet delegation. This seems to indicate that United States resumption of chemical weapons production may provide some incentive to the Soviet Union to become serious about a chemical weapons convention.

I must caution against making too much of the largely procedural progress made by the Chemical Weapons Committee during 1985. The comprehensive ban that we seek will of necessity be a complex agreement, as it must ensure both the destruction of existing chemical weapons stockpiles, and that new stocks are not illegally produced in the peaceful chemical industry. The negotiation of such a ban is perforce a complex and lengthy undertaking. At present, on the most important substantive issues, verification in particular, there continues to be little agreement. While we search for mutually acceptable solutions, we continue to view as essential the need for mandatory, short-notice challenge inspection provisions—that would apply to any government-owned or -controlled facility—to complement the more routine types of verification of such matters as the destruction of stockpiles and the non-production of chemical weapons in the chemical industry. On the other hand, we have made clear in Geneva that it is the level of verification required to satisfy security concerns, not necessarily our specific language, that is important.

Let me add that the delegation, of course, maintains close contacts with many other delegations in the Conference on these negotiations as well as on other matters. We have had a bilateral dialogue on the chemical weapons issue with the delegation of the Soviet Union, and I should be pleased to expand on those discussions in closed session.

Let me discuss with you very briefly two other agenda items which have received a considerable degree of attention in the Conference. The first is that of the prevention of an arms race in outer space. Clearly, a primary focus on this important matter is the bilateral nuclear and space talks which are to resume shortly in Geneva. However, we recognize that many states have an interest in the outer space environment. This year, the CD carried out an initial examination of outer space issues relevant in a multilateral arms control context. The United States fully participated in these activities, but thus far we do not see the possibility of identifying any particular subject as appropriate for beginning a multilateral negotiation. I expect the question of outer space to continue as a major issue in the CD.

The second item is that of a comprehensive nuclear test ban. We have made it clear in Geneva that our position continues to be that a complete cessation of nuclear explosions is a long-term objective of the United States. We have stressed that the achievement of deep reductions in the nuclear arsenals of the Soviet Union and the United States is a more meaningful approach to nuclear arms control, and should take precedence. At the CD, we have continued to support the need for substantive work on a range of test ban issues, including the scope of an eventual ban, and verification and compliance. In particular, we have endorsed, and supported with significant financial and technical resources, the group of experts in seismology and data processing that has been developing ways of exchanging sesimic data on a global basis for verification of a comprehensive test ban.

On balance, I believe that the Conference on Disarmament had a year of modest success, particularly in the area of the chemical weapons negotiations. We attempted and I believe succeeded in making clear the U.S. positions on the issues dealt with in the CD and maintained unified positions with our Allies. I am looking forward to the resumption of formal work in the Conference in February.

In the meantime, much of the focus of multilateral arms control efforts will shift to the United National General Assembly, where its First Committee will take up and debate a wide variety of arms control issues. I will be representing the United States in this work, and I will be joined by a large number of my colleagues from Geneva.

This completes my prepared remarks. I should be pleased to respond to any questions that you might have about these or other issues being addressed in the Conference on Disarmament.

Mrs. BYRON. Let me—I guess we will have to go into closed session on the questions I have. I wanted to pursue a little bit more about the changes that you saw after the House for the first time passed a chemical weapons program this year. And so I will yield to Mrs. Holt.

Do you have any questions?

Mrs. HOLT. I would like to reserve my questions until we go into closed session, too.

Mrs. BYRON. Mr. Ray.

Mr. RAY. I enjoyed your presentation. This morning I asked a question of the gentleman who appeared before us, one of your colleagues. I heard on the news this morning that Gorbachev had advanced a notion that he would consider a chemical weapons-free zone in Europe, and I asked what he thought—what was his opinion on this. Ambassador Blackwill said that it was not something new.

Do you have an opinion on it or do you know about this late evidence——

Ambassador LOWITZ. I am not aware of the statement other than coming down here having heard that such a statement was reported to have been made; but Ambassador Blackwill is right, it is not something new and it is in my judgment not something that would be advantageous for the United States. It does not do anything to ban the production or availability of chemical weapons. It merely would take the chemical weapons out of a given geographic area but would still have them available adjacent to that area for use if deemed desirable to do so.

Mr. RAY. Have such areas ever been identified, would it be the Warsaw Pact countries and Germany—do you have any particular idea of where the areas would be so identified?

Ambassador LOWITZ. I am not certain what the area would be. In some discussions that have gone on in, I believe, the SPD party in West Germany they have talked about that limited area.

Mr. RAY. Perhaps that statement by Gorbachev—would it have been generated simply by the action that the Senate and House recently took on binary weapons, would that cause an interest in him raising that question or would you have any idea?

Ambassador LOWITZ. It would be difficult to speculate.

Mr. RAY. How long have you been negotiating? You were in Geneva, right?

Ambassador LOWITZ. I am in Geneva during the sessions of the Conference, yes.

Mr. RAY. You have been there for how many years?

Ambassador LOWITZ. I just started in January of this year. I took this position in December and prepared and went over to Geneva in January for the session beginning in February.

Mr. RAY. Thank you, sir.

Ambassador LOWITZ. Thank you.

Mrs. BYRON. Mr. Courter.

Mr. COURTER. Thank you.

I, as well, enjoyed your testimony very much. Is it widely known among the 40-odd nations that you negotiate with that the Soviet Union is in violation of two important arms control agreements with respect to chemical and binary weapons?

Ambassador LOWITZ. Well, when you said widely known, it is hard to put oneself in the heads of the other delegations but clearly one of the issues that we have discussed at the Conference on a regular basis is the United States concern with the Soviet violations of treaties and the problems attendant to making certain that there will be compliance with treaties, so it is a subject with which there is familiarity.

We did provide to the Western group and to the nonaligned group a compliance briefing during the summer so that we did make available to them understandings that we have.

Mr. COURTER. Did they go to the compliance briefing?

Ambassador LOWITZ. Yes. The attendance I think was very good.

Mr. COURTER. Did the Soviets go to the compliance briefing?

Ambassador LOWITZ. No, we did not invite them.

Mr. **Courter**. Did any East bloc countries, Warsaw Pact, go to the briefing?

Ambassador **Lowitz**. No. We had two briefings, one for the Western allies and one for what is the 21-nation nonaligned group. We did not offer the briefing to the Soviets or the Eastern bloc countries.

Mr. **Courter**. I notice there is a reference in the notes in your testimony about the fact that there have been some discussions about weapons in space. Can you briefly let us know what has been talked about with regard to your 40-nation group on that?

### WEAPONS IN SPACE

Ambassador **Lowitz**. Well, the whole question of outer space is an area of great interest, obviously, to the members of the Conference. It has been our position that most of the outer space issues at this point are being addressed in the bilateral discussions between the United States and the Soviet Union, but that it was proper to have a discussion and an investigation of the issues.

Much of the time was spent discussing the existing legal regimes and their application to outer space, and that took up a great deal of time.

There were some other discussions on other areas.

Mr. **Courter**. There were discussions on space weapons or weapons in space?

Ambassador **Lowitz**. Yes, yes, there were. It is hard to——

Mr. **Courter**. What did it boil down to? You know what I am getting at. Were most countries concerned about the United States militarizing outer space?

Ambassador **Lowitz**. Well, obviously, the Soviet Union and its allies have used the Conference as another forum in which to talk about the Strategic Defense Initiative, so that has been their primary thrust. The nonaligned countries have a considerable interest in the subject, but obviously much less knowledge about it, and they exhibit a great deal of concern about the question of militarization of space.

When you start discussing in detail what is militarization of space and what has gone on there it becomes more complex and there is less general understanding. We viewed it as our role to attempt to set the record straight as much as possible, also being very cautious and conscious of the fact that this is a very major portion of the bilateral negotiations, and that we didn't want to do anything that would interfere with that.

Mr. **Courter**. I notice also there was something about a comprehensive test ban treaty. Is that very far along or are discussions with regard to a comprehensive test ban treaty very far along, and what is our position?

Ambassador **Lowitz**. Our position as I indicated in my statement was that we view achievement of a comprehensive test ban as a long-range goal and that there are other questions that ought to take precedence; namely, the reduction in nuclear weapons on both the part of the United States and the Soviet Union.

We and our allies at the Conference have maintained that even though we are not prepared at this point to negotiate such a treaty there is useful work that ought to be done as against the time when such a treaty might become appropriate.

Mr. COURTER. Why aren't we prepared to negotiate that type of a treaty, is that because of verification concerns?

Ambassador LOWITZ. That is part of the issue but not the entire issue. Perhaps that question would be best addressed to Dr. Barker, who I understand will follow me and will be discussing that in depth.

Mr. COURTER. Thank you very much.

The CHAIRMAN. Mr. Stratton.

Mr. STRATTON. Ambassador, you point out that this began with the 18-nation Disarmament Conference in 1962, subsequently expanded to 40 states as the Disarmament Committee, and now it is a Conference. How many members are in it at the present time?

Ambassador LOWITZ. It now contains 40 countries.

Mr. STRATTON. Forty?

Ambassador LOWITZ. Yes.

Mr. STRATTON. What about these additional countries? Were they included in the 40-nation Disarmament Committee as well?

Ambassador LOWITZ. Yes.

Mr. STRATTON. Brazil, Argentina, Mexico, Egypt, Mongolia——

Ambassador LOWITZ. Yes. What is now the Conference was up until 1984, I believe, called the Committee on Disarmament and it was just a change of name, but in 1979, when this format was established, it was then 40 nations and it is the same 40 nations now. The conferees determined that they would add four more countries, one from the Western Group, one from the Eastern bloc and two from the nonaligned. Since the Conference operates by consensus, they have not yet been able to reach agreement on the four countries, so that there have been no additions.

Mr. STRATTON. I think you indicated in your remarks that the action provided by the House in approving binary weapons provoked some activity on the part of the Soviet Union delegate. However, I would point out that we are not out of the woods because it is very likely, as I understand it, and as we have been led to believe, that there will be a further vote in the House on whether that provision will stay in. So Ambassador, we may get a few weeks additional respite.

Ambassador LOWITZ. Yes, I am aware of the fact that there is an additional vote that has to be had. What I tried to just set out was my perception of what happened from the time of the earlier vote and how it seems to have impacted on the activities of the Conference.

Mr. STRATTON. Thank you.

Mrs. HOLT. Will the gentleman yield?

Mr. STRATTON. Yes.

Mrs. HOLT. I just wonder if you would state what your view would be if we put restrictions on the production, restrictions on assembly and storage and deployment and all this stuff, which is possible if we come back for another vote on it, what would be the impact on your negotiating ability?

### EFFECT OF RESTRICTIONS ON NEGOTIATIONS

Ambassador LOWITZ. Well, you know, it is easier to say what I think would happen if there is no vote for the commencement of the modernization program than to know specifically what will happen if the program goes forward.

My sense is that without the program there is an absence of an incentive for the Soviet Union to negotiate seriously. They enjoy a significant chemical weapon advantage at this point, and they don't seem to have any reason not to continue that enjoyment. Were we to begin the modernization program then they would be faced with a different set of circumstances and in my judgment that could provide some of the incentive necessary to have them go forward and negotiate more seriously.

Mrs. HOLT. So you think it would make your job a little easier?

Ambassador LOWITZ. Yes, I do.

Mrs. HOLT. Thank you.

Mr. STRATTON. If I could ask another question, Madam Chairman. I was in Germany during the recess, and it was the almost unanimous agreement of all of our troop commanders that it would have to take a miracle from heaven for the allies to agree to the placing of binary weapons in their territory.

Does that point of view apply to the members of this conference who are part of the NATO operations?

Ambassador LOWITZ. Actually, that specific question has not come up within the meetings that I have had with my allied colleagues during the session.

We have not specifically been discussing the possibility of putting these weapons on their territory. My understanding is that the administration has indicated that there are currently no plans for such stationing, and I assume that that has just not been an issue that we have discussed.

Mr. STRATTON. Well, the program that we approved which you indicate represents a significant change does involve the acceptance, either silently or out loud, of these weapons, and that is the one thing that the American commanders in Germany feel very strongly is probably not going to happen, take place in the immediate future, or perhaps not until hell freezes over.

Mrs. BYRON. Mr. Spratt.

Mr. SPRATT. I believe, Mr. Stratton, that the final version of the conference report simply calls for consultation by the President and the Department of Defense with NATO allies, it does not require a tacit acquiescence or any kind of verbal consent, simply consultation, so it has been worn down from what it originally started out to be.

I would like to pick up on the point made because when we did put conditions in the chemical weapons authorization requiring NATO consultation and at least tacit consent by the countries where the binary weapons would be stored or deployed we found that there was tremendous resistance from our NATO Ambassador and from the Department of Defense.

Apparently the issue is a little too hot to handle in NATO. Given that fact, given the fact that it does not appear that the European NATO allies will allow the replacement of the existing unitary stock with the new binary weapons or deployment and storage of these weapons in the near future, wouldn't it be in our interest to begin considering at least the possibility of a chemical weapons free zone, if we are not going to be able to store our weapons in Europe, don't we have an interest in trying to negotiate with the Soviets a removal of their stored weapons in the Warsaw Pact nations?

Ambassador LOWITZ. Well, but their removal would be of much closer proximity to the area than our removal would be so I don't think that that would solve the problem. I think the problem is best solved by achieving a chemical weapons ban.

Mr. SPRATT. I agree but that may be a long way off and it may never happen. I wonder if we can ever arrive at satisfactory verification provisions and dealing in second best solutions—isn't that something worth pursuing and considering, particularly if we can't keep our chemical weapons there, if we can get them to withdraw theirs back to the Soviet Union?

Ambassador LOWITZ. I think that is a question probably better answered by the military people, but my understanding is that the question of that kind of zone in Europe would pose significant military problems for us.

Mr. SPRATT. I have only heard this secondhand but is it correct that the Social Democratic Party in Germany has made some sort of agreement with the East Germans that if and when the SPD returns to power they will negotiate a chemical weapons-free zone in East Germany?

Ambassador LOWITZ. That has been substantially reported in the European press and I think has been referred to by the East German representative at least at the Conference on Disarmament. There are statements to that effect which I think are geared to a number of different political—domestic issues in West Germany.

Mr. SPRATT. Would you elaborate on what we are asking for in the way of verification not as to destruction of existing stocks, but as to production of new stocks, what are the verification requirements in the treaty drafted by Vice President Bush.

### VERIFICATION REQUIREMENTS

Ambassador LOWITZ. We feel that it is necessary in order to assure compliance with a treaty of this sort, keeping in mind that chemical weapons are weapons that can be easily produced and can be produced with very short startup time, that every member or party to the convention have the right when it suspects that there has been a violation of the treaty to go in and make an inspection on very short notice.

Mr. SPRATT. Would it be a consultative commission?

Ambassador LOWITZ. There are provisions for a number of possible steps. This would not be the first thing and perhaps if you wish I could submit a more detailed answer in writing so you would have the entire setup laid out.

Mr. SPRATT. In addition to that sort of ad hoc notice challenge inspection procedure, is there another sort of periodic inspection rate where periodically, say once a year or every 2 years, we would have a right to inspect areas of the Soviet Union where chemical weapons might be?

Ambassador LOWITZ. There are a number of rights with respect to destruction, in connection with destruction of the stockpile, with destruction of the facilities, so there are a number of different procedures, but it is our judgment that we need this on-site inspection—the challenge inspection—to have the certainty that there will be compliance with the treaty.

Mr. SPRATT. Once destroyed and once we were satisfied they had destroyed their stocks, would we depend upon this short notice challenge provision for ongoing verification?

Ambassador LOWITZ. Obviously, because it would impact on all parties equally it would be something that would not be frivolously used or used as a first step. It is something that we believe is necessary in the process in order to assure compliance. There are also other means, such as routine inspections of the chemical industry and other means of checking.

Mr. SPRATT. Has the Soviet Union made any counterproposal with regard to verification? Do they have a position and offer on the table with respect to the verification?

Ambassador LOWITZ. They have not seen fit to really respond directly to our proposal. They have taken a position primarily of just condemning it out of hand. They do, in things that they have submitted, propose what is really a self-inspection regime, which is really not any inspection. So that is where they stand at this point.

Mr. SPRATT. Thank you.

Mrs. BYRON. Mr. Mavroules.

Mr. MAVROULES. Thank you, Mr. Ambassador.

I would like to pursue the line of questioning put forth by my colleagues who spoke with you previously and also refer to something on page 7.

Do you honestly believe that because the action taken by the House that that really accelerated the Soviet Union to come back negotiating perhaps more objectively on chemical warfare?

Ambassador LOWITZ. Well, it is a question that I have thought about because it is obviously not easy to know for certain what motivates the Soviet Union to take the action they take.

But in looking at the activities that occurred there and what their initial response was, which was an attempt to condemn the action and to resort to polemics, and then a short period of silence, and then a more active involvement, at least the beginnings of some interest in asking questions and trying to get at the issues, I have to conclude that it may well have had some effect.

I think that it is hard to quantify, but I do think that absent something like a resumption of production here there is less likelihood of there being any incentive for the Soviet Union to negotiate when they now enjoy such a substantial advantage.

Mr. MAVROULES. Well the reason I asked the question, you realize, of course, that through the actions taken by the House that the final product, according to my colleague Mr. Spratt, would not be out there until 2 years down the road, 1988.

I wonder if that really was the incentive to bring them back or are you free to share with us what did happen? What did you talk about? What was done that was constructive?

Ambassador **Lowitz**. Let me address the first question.

I think that the fact that the actual production would not commence for a period of time is not to say that it doesn't make any effect, because if they have the knowledge that absent an agreement there will be production, there then is this period of time to see whether or not they will be serious about the negotiations. So I think that even with the span of time before the first binary weapon would be produced there is still the incentive factor there.

As far as what the behavior was, there were statements in the plenary sessions, there were statements in the committee, there was a kind of polemical attack on the program, and then a period of time when the Soviet Union just sat back at the committee meetings and did very little, said very little, and then the beginnings of some greater participation again in the committee. What little progress was made was, in fact, made in those last weeks of the committee.

Mr. **Mavroules**. Thank you. I just have another question.

I am asking for your judgment on this. On page 7, I want to commend you and the administration for that matter on the so-called comprehensive nuclear test ban, that we would all like to see occur.

In your judgment, if we voluntarily, the United States, let us assume took a position that we weren't just going to test for a period of 6 months without calling the bluff of the Soviet Union, what would that do to our national security if anything? Would you care to share your views with us?

Ambassador **Lowitz**. I don't feel competent to make that kind of military judgment. Perhaps that is a question also that Dr. Barker would be better prepared to answer.

Mr. **Mavroules**. Thank you.

Mrs. **Byron**. I think next we should have Dr. Barker's testimony. Ambassador, how is your timeframe?

Ambassador **Lowitz**. It is fine.

Mrs. **Byron**. I think we will do that and then go into a closed session.

Ambassador **Lowitz**. Fine. Thank you.

## STATEMENT OF DR. ROBERT BARKER, DEPUTY ASSISTANT DIRECTOR, BUREAU OF VERIFICATION AND INTELLIGENCE, U.S. ARMS CONTROL AND DISARMAMENT AGENCY

Mrs. **Byron**. You may proceed.

Dr. **Barker**. Thank you, Madam Chairman.

Good afternoon. I am happy to appear before you this afternoon to talk about the administration's nuclear testing arms control policy. Later on in these hearings you will be hearing more in detail from both the Department of Defense and the Department of Energy on some of the more technical aspects of these issues.

I would like to start off that process by talking a little bit about U.S. arms control policy in this area and I would like to abbreviate my remarks and submit more detailed remarks for the record.

## NUCLEAR TESTING ARMS CONTROL POLICY

Nuclear test limitations have played and will continue to play a role in the arms control policy of the United States. That role will be one consistent with promotion of national security. There is apparently strong congressional interest in three areas of nuclear test limitations policy, the signed but unratified Threshold Test Ban Treaty, the TTBT, and its companion Peaceful Nuclear Explosions Treaty, PNET; second, a comprehensive test ban or [CTB] treaty; and third, the recent nuclear test moratorium proposal of the Soviet Union.

I have noted that in Mrs. Byron's opening statement she expressed the belief these hearings should provide the panel with a better understanding of the issues involved in these measures.

I join in that hope and hope that that understanding will go beyond this panel to the Congress as a whole.

U.S. policy on each of the three issues of nuclear testing policy is clear. The U.S. positions have evolved from careful evaluations of all relevant issues, giving full consideration to national security and the fundamental arms control requirements that any treaty to which the United States is a party must be effectively verifiable.

I will summarize briefly the U.S. position. Careful study led us over 4 years ago to conclude that the Threshold Test Ban Treaty in its current form is not effectively verifiable. Ratification of this treaty before verification improvements can be negotiated with the Soviet Union is not in the national interest of the United States. The United States is committed to achieving effective verification of the Threshold Test Ban Treaty. The United States has been very committed to trying to achieve those improvements in verification.

In 1983, in 1984, on a number of occasions, we sought to engage the Soviet Union in discussions on verification improvements for the Threshold Test Ban Treaty and the Peaceful Nuclear Explosions Treaty.

In his address to the United Nations General Assembly on September 24, 1984, President Reagan proposed an exchange of visits to allow Soviet experts to come to the U.S. nuclear test site and U.S. experts to go to a Soviet nuclear test site to measure directly the yields of nuclear weapons tests. Those suggestions, those attempts to meet with the Soviet Union, were all rebuffed.

On January 29, in an unprecedented move, the President clearly demonstrated his willingness to go the extra mile in order to begin a process that might ultimately lead to effective verification of the Threshold Test Ban Treaty. The President invited the Soviet Union to send experts, with any instrumentation devices they deem necessary, to measure the yield of a nuclear test at the U.S. test site. The invitation was without preconditions. The Soviets have yet to accept even this no-strings offer.

Returning to the subject of the comprehensive test ban, a thorough reevaluation almost 4 years ago led the administration to reaffirm that a comprehensive test ban remains a long-term objective of the United States, an objective we will seek to pursue within the context of broad, deep, and verifiable arms reductions; maintenance of a credible nuclear deterrent; expanded confidence building measures and improved verification capabilities.

There is much to be accomplished with respect to each of these objectives; it is not yet time to undertake negotiations of a comprehensive test ban. Returning to the moratorium, the United States long ago determined that our interests cannot be served by participation in an uninspected nuclear test moratorim such as the Soviets have proposed.

This judgment is soundly based on historical experience, most acutely when the Soviets broke the previous 1958–1961 nuclear testing moratorium by conducting some 40 atmospheric tests in a 2-month period. In a cogent way, President Kennedy summarized the lesson learned when he said in 1962: "We now know enough about broken negotiations, secret preparations, and the advantage gained from a long test series never to offer again an uninspected moratorium."

This administration is committed to effective arms reduction agreements and to the ultimate objective of the total elimination of nuclear weapons.

We seek to achieve the elimination of nuclear weapons while striving to strengthen and maintain the security and stability the world desires.

In this context we are convinced that reductions in the offensive nuclear weapons of the Soviet Union and the United States must have our highest priority. The return earlier this year of the Soviets to the negotiating table have given us the opportunity to resume our effort in this regard. In seeking deep reductions we will demand equality and require effective verification of any resulting treaty.

These criteria are critical for strategic stability. It is important to understand that our reliance on a credible nuclear deterrent has an essential bearing on the timeframe within which consideration can realistically be given to negotiations of a comprehensive test ban.

The current directors of the nation's two nuclear laboratories have stated, "Continued nuclear testing is absolutely essential to insure the reliability of our nuclear weapons." Later in these hearings, representatives from the Department of Defense and the Department of Energy will address in greater detail this relationship between nuclear weapon reliability and testing.

Ultimately, however, full appreciation of the role which nuclear weapons testing places in the maintenance of our national security requires access to classified information.

Fortunately, the entirety of this information is available to those in Congress who seek it. The administration's central objective is radical reductions in the number of existing nuclear weapons, with the ultimate goal of ridding the world of the nuclear threat.

Congressional support for U.S. efforts to achieve such reductions in the current Geneva negotiations has been substantial and we believe such support is not lost on the Soviets.

Clearly, where the administration and Congress are seen working together, our chances for success with the Soviets are greatest. We welcome enthusiastic and knowledgeable congressional support for our nuclear test limitations arms control policy.

Thank you.

## PREPARED STATEMENT OF DR. ROBERT BARKER

Good afternoon, I am happy to appear before you this afternoon for the purpose of addressing the Administration's nuclear testing arms control policy.

Nuclear test limitations have played and will continue to play a role in the arms control policy of the United States. That role will be one consistent with the promotion of national security. The Congress of the United States in establishing the Arms Control and Disarmament Act has noted that, "Arms control and disarmament policy, being an important aspect of foreign policy, must be consistent with national security policy as a whole."

There is apparently strong current Congressional interest in three areas of nuclear test limitation policy: the signed but unratified Threshold Test Ban Treaty (TTBT) and its companion Peaceful Nuclear Explosions Treaty (PNET); a Comprehensive Test Ban, or CTB Treaty; and the recent nuclear test moratorium proposal of the Soviet Union.

U.S. policy on each of these issues is clear, the U.S. positions have evolved from careful evaluation of all relevant issues, giving full consideration to national security and the fundamental arms control requirement that any treaty to which the U.S. is a party must be effectively verifiable.

Careful study led us, over four years ago, to conclude that the Threshold Test Ban Treaty, in its current form, is not effectively verifiable; ratification of this Treaty before verification improvements can be negotiated with the Soviet Union is not in the national interest of the United States. The United States is committed to achieving effective verification of the TTBT.

Similarly, thorough evaluation has led the Administration to reaffirm that a comprehensive test ban remains a long-term objective of the United States; an objective which we will seek to pursue within the context of broad, deep and verifiable arms reductions, maintenance of a credible nuclear deterrent, expanded confidence-building measures and improved verification capabilities. There is much to be accomplished with respect to each of these objectives; it is not yet time to undertake negotiation of a comprehensive test ban.

The United States long ago determined that our interests cannot be served by participation in an uninspected nuclear test moratorium, such as the Soviets have proposed. This judgment is soundly based on historical experience, most acutely when the Soviets broke the previous 1958–1961 nuclear testing moratorium by conducting some 40 atmospheric tests in a two-month period. In a cogent way, President John F. Kennedy summarized the lesson learned when he said in 1962:

"We know now enough about broken negotiations, secret preparations, and the advantages gained from a long test series never to offer again an uninspected moratorium."

This Administration is committed to effective arms reductions agreements and to the ultimate objective of the total elimination of nuclear weapons.

The President has said,

"My central arms control objective has been to reduce substantially and ultimately to eliminate nuclear weapons and rid the world of the nuclear threat. Toward that end, the United States has proposed in Geneva radical reductions in the number of existing nuclear weapons. This, I believe, is the most direct and best course to pursue if we are to eliminate the danger of nuclear war.

"At the same time, I believe that verifiable limitations on nuclear testing can play a useful, although more modest, role."

We seek to achieve the elimination of nuclear weapons while striving to strengthen and maintain the security and stability which the entire world desires. In this context, we are convinced that deep reductions in the offensive nuclear weapons of the Soviet Union and the United States must have our highest priority. The return, earlier this year, by the Soviets to the negotiating table has given us the opportunity to resume our effort in this regard. In seeking deep reductions we will demand equality and require effective verification in any resultant treaty. These criteria are critical for strategic stability.

Furthermore, we and the whole world must be convinced that agreements negotiated are agreements to be complied with. Unfortunately, the Soviet record on compliance, rather than giving increased confidence in arms control, gives rise to grave concerns. As the President has said:

"Soviet noncompliance is a serious matter. It calls into question important security benefits from arms control, and could create new security risks. It undermines the confidence essential to an effective arms control process in the future."

The Threshold Test Ban Treaty offers an area where the Soviets can demonstrate that they take arms control seriously, that they too recognize that the true benefits of arms control can only be achieved when all parties are secure and confident that the treaty terms are being complied with. The United States must stand by its standard of effective verification with respect to the Threshold Test Ban Treaty; anything less would undermine our ability to demand effective verification in this and other treaty areas, as well as being a disservice to the objectives of the TTBT.

There is almost universal acceptance in this country that true treaty verification cannot be based upon trust. Yet the TTBT, in the name of verification, offers only an exchange of data which, while appearing extensive, contains not a single meaningful element that can be independently validated by the United States. There is no ability for us to independently measure any of the important parameters upon which our estimates of Soviet yield are based.

Those who negotiated and signed the TTBT, with today's hindsight, were optimistic. They believed that our understanding of the science of seismology was good enough for us to determine Soviet nuclear weapon test yields to an accuracy sufficient to protect U.S. security. They also expected that the Soviets would comply with the treaty. Since 1976, when the Soviet Union claimed that it would abide by the provisions of the TTBT, two things have happened to change that earlier perspective. First, we have had to recognize that we cannot determine Soviet nuclear yields with the accuracy required for effective verification. Secondly, we have had to conclude that it is likely that the Soviets have violated their legal obligation with respect to the TTBT. As reported by the President in 1984 and 1985, in the Congressionally mandated reports on Soviet noncompliance with arms control agreements, while ambiguities in the pattern of Soviet testing and verification uncertainties continue to exist, evidence available leads to the conclusion that Soviet nuclear testing activities for a number of tests constitute a likely violation of the 150 kiloton limit.

The TTBT cannot now be effectively verified. The Soviets are in likely violation of their legal obligation to limit test yields to 150 kilotons and below. Verification must be improved before the President could in good faith determine that this treaty is in the national security interest of our nation and before he could thus seek the advice and consent of the Senate to its ratification.

The Administration has not been passive on this issue. In 1983 and 1984 we sought on a number of occasions to engage the USSR in discussions on verification improvements for the TTBT and PNET. In addition, in his address to the United Nations General Assembly on September 24, 1984, President Reagan proposed an exchange of visits to allow Soviet experts to come to the U.S. nuclear test site and U.S. experts to go to a Soviet nuclear test site to measure directly the yields of nuclear weapons tests. We recognize that any improvements to verification of the TTBT must be mutually arrived at—must be negotiated. They cannot be dictated by the United States and imposed upon the Soviet Union. For this reason we have not approached the Soviets with a unilateral, non-negotiable demand; we have instead sought an honest exchange of technical views on how verification can be improved. Regrettably the Soviets have thus far rejected all our proposals to meet and confer on verification improvements.

On July 29, in an unprecedented move, the President clearly demonstrated his willingness to go the extra mile in order to begin a process that might ultimately lead to effective verification of the TTBT. The President invited the Soviet Union to send experts, with any instrumentation devices they deem necessary, to measure the yield of a nuclear test at the U.S. test site. The invitation was without preconditions. The Soviets have yet to accept even this "no strings" offer.

The Soviets can have no doubt about the Administration's position—effective verification must precede ratification. We would welcome Congressional endorsement and support for the Administration's efforts to strengthen verification measures as a precondition for ratification.

U.S. policy with respect to the Comprehensive Test Ban Treaty is no less clear. We would all like to reduce and eventually eliminate our dependence upon nuclear arms. However, as the current discussion of the Strategic Defense Initiative has highlighted, many Americans, as well as American allies are seeking assurance that the U.S. nuclear deterrent will be effectively maintained until a better alternative is available. Today, this requires nuclear testing.

As we modernize our nuclear deterrent to make it more survivable and better able to contribute to stability, we will require some new nuclear weapons to arm those new weapon systems. In the interest of stability we must also retain our confidence that our deterrent is reliable. And, while the safety and security record of our nuclear forces is unparalleled, as technologies come available which can make them even more safe and secure, who would bear the burden of not incorporating those improvements into our nuclear weapons? Weapon modernization, confidence in the deterrent, and enhanced nuclear weapon safety and security are today all dependent upon nuclear testing.

It is important to understand that our reliance on a credible nuclear deterrent has an essential bearing on the time frame within which consideration can realistically be given to negotiation of a CTB. The current Directors of the nation's two nuclear laboratories have stated: "Continued nuclear testing is absolutely essential to ensure the reliability of our nuclear weapons." Later in these hearings, representatives from the Department of Defense and the Department of Energy will address in greater detail this relationship between nuclear weapon reliability and testing. Ultimately, however, full appreciation of the role which nuclear weapons testing plays in the maintenance of our national security requires access to classfied information. Fortunately, the entirety of this information is available to those in Congress who seek it.

As with the case of the TTBT, effective verification is also a necessary condition for a Comprehensive Test Ban Treaty. Today it does not exist. The U.S. has spent hundreds of millions of dollars on research to establish the basis for verifiable nuclear test limitations. This Administration is continuing that search. As part of that effort we have actively supported multilateral involvement in nuclear test ban verification studies at the 40-Nation Conference on Disarmament in Geneva.

In sum, the ingredients are not yet available for comprehensive test ban negotiations. Further, we must not allow a search for a CTB to become once again a diversion and surrogate for negotiations of deep and meaningful arms reductions. The signatories of the Non-Proliferation Treaty sought in Article VI of that Treaty the elimination of the discrimination that is manifest in the differentiation between nuclear weapon states and non-nuclear weapon states. Elimination of the distinction can only be achieved with the elimination of nuclear weapons; radical reductions in the number of offensive nuclear weapons should be the first step in that direction.

A nuclear-testing moratorium, such as that proposed by the Soviets, is an invitation to a comprehensive test ban with no semblance of verification. The lack of verification is sufficient basis for rejection. Moratoria are never acceptable substitutes for negotiated, effectively verifiable arms control agreements. Further, the reasons for rejecting a moratorium are identical to those for rejecting the negotiation of a comprehensive test ban at this time.

President Kennedy's 1962 statement on a nuclear testing moratorium, when quoted more extensively, details his extensive appreciation of the threat which is posed by such a moratorium.

"We know now enough about broken negotiatons, secret preparations, and the advantages gained from a long test series never to offer again an uninspected moratorium. Some may urge us to try it again, keeping our preparations to test in a constant state of readiness. But in actual practice, particularly in a society of free choice, we cannot keep topflight scientists concentrating on the preparation of an experiment which may or may not take place on an uncertain date in the undefined future. Nor can large technical laboratories be kept fully alert on a standby basis waiting for some other nation to break an agreement. This is not merely difficult or inconvenient—we have explored this alternative thoroughly, and found it impossible of execution."

With this country's experience with a nuclear-testing moratorium it is almost incredible that any, even the current Soviet leadership, could believe we would find a moratorium to be a serious alternative to real arms control.

The Administration's central objective is radical reductions in the number of existing nuclear weapons, with the ultimate goal of ridding the world of the nuclear threat. Congressional support for U.S. efforts to achieve such reductions in the current Geneva negotiations has been substantial and we believe such support is not lost on the Soviets. Clearly, where Administration and Congress are seen working together, our chances for success with the Soviets are greatest. We welcome enthusiastic and knowledgeable Congressional support for our nuclear test limitation arms control policy.

This completes my prepared remarks. I will be happy to answer your questions.

Mrs. BYRON. Let me pursue a little bit a statement you made in your last paragraph, where the administration and Congress are seen working together our chances for success with the Soviets are the greatest. Do you find that when there seems to be in the news media a perception that there is a difference within Congress or between Congress and the administration that hinders negotiations and the talking process?

Dr. **Barker**. We have learned that the Soviets have a great deal of patience; they are willing to wait a very long time to achieve their objectives. Whenever they see disarray within the American Government and they see one point of view potentially providing them an opportunity to delay, I think they will take that opportunity and fail to face up to the priorities that we would like them to address.

Mrs. **Byron**. Following that a little bit further, the concern of almost everyone is the difficulty in verification but above and beyond the difficulty in verification, have we moved forward on any other area of negotiations taking that aside? Do you see any progress at all?

Dr. **Barker**. At the current time—the three areas that I have mentioned, with respect to the Threshold Test Ban Treaty, the sole remaining issue is one of verificaton. We signed the treaty in 1974. I think at the same time, and with hindsight we can say with a certain amount of optimism, we believed that we would have the basis for effectively verifying that treaty and also believed that the Soviets would adhere to its provisions.

Unfortunately, events since then have led us to conclude that we cannot effectively verify that treaty. However, we are still living up to its terms, we still stand ready to ratify that treaty provided that we can indeed achieve the conditions for effective verification. So far we have been rebuffed time and time again as far as improving the verification provisions. With respect to a comprehensive test ban treaty there are prior conditions before it would be time to negotiate with the Soviet Union on that subject.

One of those areas is a need for improved verification over and above what current technology can offer us. This country has spent in the neighborhood of half a billion dollars over the past decades to improve our ability to verify a comprehensive test ban treaty. We continue to pursue improved verification not only on our own but also in the context of the 40-nation conference that Ambassador Lowitz just spoke of.

Mrs. **Byron**. Mrs. Holt.

Mrs. **Holt**. Thank you.

Dr. Barker, isn't verification the bottom line? Really, we can't negotiate any kind of effective treaty in anything if we can't verify it.

Do you see any hope that the Soviets would ever agree to real verification in the kind of closed society that they have?

Dr. **Barker**. I think we have to try, Mrs. Holt.

Mrs. **Holt**. I agree.

### VERIFICATION

Dr. **Barker**. While some of us may be optimistic and some very pessimistic about the Soviets ever agreeing to conditions which would allow for effective verification across a broad range of treaty areas, the organization of which I am a part; namely, the Verification and Intelligence Bureau of the Arms Control and Disarmament Agency, our primary objective is to attempt to design verification measures which offer the hope of effective verification should the Soviets accept them, and also to try to influence the treaty drafting process so that we can write treaties which have a hope of being verified.

Mrs. **Holt**. I certainly agree that you have to be an optimist to have the job that you have, just as we have to be optimistic to come into Washington every day and get our brains kicked out over here. I really have decided that there isn't a lot of hope in talking with people in the Soviet Union. They make no bones about it. You have to devise ways to verify it on your own or else let us verify it for you and tell that it is all right.

And there is no way that we can go underground with the large land mass they have. It seems to me that unless we show you or get that political goodwill that they keep talking about, it is going to be impossible to verify it.

Dr. **Barker**. I would only add to those comments, I think, the worst thing we can do is to give up the standard of effective verification. That is why the Threshold Test Ban Treaty is such a significant issue. One runs into people who say, "Does it really matter if the Soviets cheat on the Threshold Test Ban Treaty?"

One finds people arguing that particular issue. I think there are significant security elements to the question, but over and above that, I think for us to abandon the standard of effective verification in any treaty area is a grave mistake, and certainly we should not begin the erosion of that process by any attempt to ratify the Threshold Test Ban Treaty in its current form.

Mrs. **Holt**. I certainly agree with you, and I commend you for the efforts that you are putting forth. We thank you very much.

Dr. **Barker**. Thank you.

Mrs. **Byron**. Mr. Ray.

Mr. **Ray**. No questions.

Mrs. **Byron**. Mr. Stratton.

Mr. **Stratton**. No questions.

Mrs. **Byron**. Mr. Mavroules.

Mr. **Mavroules**. Thank you. I just have one question.

I am not sure that you can answer that in open session. You can take a shot at it. I do see that on future witnesses that that question is going to be asked.

I am not advocating this, so don't get me wrong. There is a lot of talk about, why doesn't the United States take the initiative and show and demonstrate to the rest of the world that we mean what we say when we talk about a comprehensive test ban treaty.

What would happen, in your judgment, if you can share with us your views, if we were to take that initiative for 6 or 9 months? We are not going to do any testing at all. We call the bluff of the Soviet Union. Let's see if they will follow suit. Would that have any adverse effects upon our national security?

Dr. **Barker**. What I would like to do is return to President Kennedy's remarks in more detail than I did in my opening comments.

Remember, the Soviet offer for a moratorium is not just for 5 or 6 months, but is an unending moratorium as long as both sides agree, and after the 1958–1961 experience, President Kennedy summarized it in 1962 when he really detailed some of the real problems associated with a moratorium.

He began with the sentence I read a moment ago. "We know now enough about broken negotiation, secret preparations and the advantages gained from a long test series, never to offer again an uninspected moratorium."

Some may urge us to try it again, keeping our preparations to test in a constant state of readiness, but in actual practice, particularly in a society of free choice, we cannot keep topflight scientists concentrating on the preparation of an experiment, which may or may not take place, on an uncertain date in the undefined future, nor can large technical laboratories be kept fully alert on a standby basis waiting for some other nation to break an agreement.

This is not merely difficult or inconvenient. We have explored this alternative totally and found it impossible. The administration has devoted a great deal of study to the issue on a comprehensive test ban and has concluded and has made a commitment to it as a long-term goal, and has, I think, clearly articulated the relationship of nuclear testing to the maintenance of the nuclear deterrent and a nuclear test moratorium is merely a CTB without any separate plans of verification.

We should have only had to have the lesson taught once; namely, in the 1958–1961 period, never to even consider it again, in my opinion.

Mr. **Mavroules**. I have no argument with what President Kennedy had stated. Any initiative on my part as an individual member would have to be bilateral—let there be no question about that, but you still haven't answered my question.

In your judgment, if we were to take that initiative as some have stated in the Congress, that we take that, universal, unilateral initiative, what would that do to our national security, our 9 or 12 months?

Dr. **Barker**. It would clearly start the process of erosion that President Kennedy referred to. The longer a nuclear test ban were in effect, the greater the significance of that erosion, and a moratorium without verification would provide us with absolutely no assurance that the Soviets were living up to their part of the bargain.

A moratorium has to be the worst of all possible deals. When it comes to consideration of nuclear test limitation treaties, or nuclear test limitation agreements.

Mr. **Mavroules**. Thank you.

Mrs. **Byron**. Mr. Klein, do you have any questions in open session.

Mr. **Klein**. Not in open session.

Mrs. **Byron**. Mr. Mansfield.

Dr. **Mansfield**. No.

Mrs. **Byron**. Mr. Scrivner.

Mr. **Scrivner**. No.

Mrs. **Byron**. I think, then, we have the authority to go into closed session, which we will do at this time.

[Whereupon, at 3:10 p.m., the subcommittee proceeded into other business.]

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# OVERVIEW OF CURRENT ARMS CONTROL POLICY

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House of Representatives, Committee on Armed Services, Special Panel on Arms Control and Disarmament of the Procurement and Military Nuclear Systems Subcommittee

*Washington, DC., Thursday, September 12, 1985.*

The special panel met, pursuant to call, at 10:15 a.m., in room 2212, Rayburn House Office Building, Hon. Beverly Byron (chairman of the special panel) presiding.

## STATEMENT OF HON. BEVERLY B. BYRON, A REPRESENTATIVE FROM MARYLAND, CHAIRMAN, SPECIAL PANEL ON ARMS CONTROL AND DISARMAMENT OF THE PROCUREMENT AND MILITARY NUCLEAR SYSTEMS SUBCOMMITTEE

Mrs. Byron. Good morning.

The panel will resume its oversight hearings on arms control and disarmament matters. On September 10, the panel received excellent briefings from Ambassador Robert Blackwill and Ambassador Donald Lowitz on the negotiations of the Mutual and Balanced Force Reductions [MBFR] negotiations in Vienna and the activities of the Conference on Disarmament [CD] in Geneva, including negotiations toward a comprehensive chemical weapons ban.

Also, on September 10, the panel received an initial briefing on verification requirements from Dr. Robert Barker from the U.S. Arms Control and Disarmament Agency [ACDA]. Although we would have preferred to set the tone for this series of hearings with an overview presentation by the Honorable Kenneth Adelman, the Director of the U.S. Arms Control and Disarmament Agency, the limited time available for panel hearings, and Mr. Adelman's previous commitments, would not permit his appearance until today.

At this point, I want to welcome Mr. Adelman on behalf of the panel.

In my letter inviting Mr. Adelman to appear at these hearings, I mentioned several areas that I believe to be of particular interest to the members of the panel. Among these issues were the following:

The Nuclear Nonproliferation Treaty [NPT], the NPT review conference scheduled to conclude on September 24, and the perceived connections between the NPT and various test ban proposals.

The interim restraint policy, as announced by the President's statement and message to the Congress on June 10, 1985, and the "appropriate and proportionate" responses to Soviet noncompliance with arms control obligations as contained in reports to the Congress in January 1984 and February 1985. In this connection, the panel will be most interested to hear what, if any, corrective actions the Soviet Union has agreed to take as a result of negotiations within the Standing Consultative Commission [SCC].

The administration's policy with respect to the "offers" reported to have been made by General Secretary Gorbachev which appear to be external to the ongoing formal negotiations. These include: a moratorium on nuclear testing; a moratorium on ASAT testing; and establishment of nuclear-free and chemical weapons-free zones in Europe.

The President's certification to the Congress with respect to testing the U.S. ASAT system; and

The administration's position with respect to House Joint Resolution 3 and H.R. 3100 dealing with ratification of the Threshold Test Ban Treaty [TTBT], the PNE Treaty, and with a freeze on various weapons systems, respectively.

During the afternoon meeting today, the panel will meet in closed session to hear briefings from Ambassadors Kampelman, Tower, and Glitman on the first two rounds of negotiations in Geneva on strategic nuclear arms, intermediate range nuclear forces, and defense and space arms issues.

Welcome, Ambassador Adelman. We look forward to your testimony this morning.

Mr. Adelman. Thank you very much, Chairman Byron.

Mrs. Byron. Before you testify, Mrs. Holt will give some opening remarks.

### STATEMENT OF HON. MARJORIE S. HOLT, A REPRESENTATIVE FROM MARYLAND, RANKING MINORITY MEMBER, SPECIAL PANEL ON ARMS CONTROL AND DISARMAENT OF THE MILITARY PROCUREMENT AND MILITARY NUCLEAR SYSTEMS

Mrs. Holt. Let me just say a couple of things. I welcome you and want to express my personal appreciation to you for the outstanding manner in which you have handled a very difficult job. We have had you before the panel a number of times. You have stayed in touch with us and been extremely supportive in providing the information that we need.

Let me mention a couple of things that haven't been fully explained.

First, it was asked what harm would it do to accept the Soviet offer of an unnegotiated moratorium on nuclear testing for a period of only 6 months. What exactly would a 6-month unnegotiated moratorium accomplish?

A second issue was not addressed. That issue is: So long as the United States, NATO and our Pacific allies depend upon nuclear weapons as a U.S. nuclear deterrent to conventional or nuclear war, does a comprehensive test ban—that is no testing at all—make any sense whatever even if such a test ban were to be 100 percent verifiable? In the absence of some movement toward worldwide nuclear disarmament, it seems that this issue far overrides the verification and proliferation issues. Yet, this issue is seldom mentioned.

I would like to have your view and the Agency and administration view on this particular question.

Thank you.

Mrs. **Byron**. Ambassador Adelman, you may proceed.

## STATEMENT OF HON. KENNETH ADELMAN, DIRECTOR, U.S. ARMS CONTROL AND DISARMAMENT AGENCY

Mr. **Adelman**. It is always a pleasure to appear before this panel. Let me just put my prejudices forward. It is one of my favorite congressional groups and certainly one with which I cherish the relationship. I welcome your advice and counsel on these issues.

Ever since the time that I served in the trenches in New York with Sam Stratton where he really led the way on the second special session on Disarmament for the United States, I have felt a certain kinship with this group and it has extended beyond Congressman Stratton and throughout the whole group, so I welcome this opportunity.

Second, let me say that I think it is a very good thing and a sign of the seriousness of this group for the group to be planning to go to Geneva and Vienna.

I have always been, I guess, a minority in Washington that thinks congressional travel is positive, and that when you have Congressmen go over to see the situation firsthand, there is a great educational function to be served. I know that despite all the trepidations that are usually associated with having congressional involvement in arms control, by my own evaluation, it has been a very positive development. Why is that? Because you have a group of Congressmen, first of all, that are serious about the issue, taking the trouble to go over.

Second, they do virtually nothing else for a day or two but learn about the arms control issue. I think anybody learning about arms control issues realizes not only the seriousness of the issue, but the complexities of the issue and the Soviet machinations on arms control and it moves from a plane of a general when are we going to have an arms control agreement, to when are we going to get the Soviets to be serious about having deep reductions, leaving the stability of the United States and our friends and allies in the world in better shape; an arms control agreement can help in that regard or can hurt in that regard. So I think that this panel's upcoming trip to Geneva and Vienna is a very positive thing.

I have a prepared statement that I would like to submit for the record. It was carefully done. I still maintain it is worth careful reading and it really has the main points of what we hope to do.

I would like your permission to submit it for the record and we will be happy to answer questions on it. It takes a tone of being realistic, but hopeful, in the upcoming rounds.

I think I can cover most of the points in the testimony by going through, Madam Chairman, your agenda on page 2.

Let me make a few points on each of your particulars and then open it up for questions.

On the Nuclear Nonproliferation Treaty and the review conference, I was there for the beginning of the first week. The tone there was good. By and large, the developing countries would like to have the United States and the Soviets do more on arms control, the article VI controversies.

In my statement, the U.S. statement to the conference, we said that we would like to see more accomplished in arms control and that there is no monopoly among Third World countries for disappointment in arms control. We made clear that we share that disappointment. We think the Nonproliferation Treaty is very helpful to our security and to the security of others around the world, including its 130 states party to the NPT. We have been working with the Soviets so there are not polemics at the conference. This is one area where we share a great deal with the Soviet Union and will continue to share a great deal.

On the interim restraint policy, I don't know if I have a lot to add to what the President announced. He is saying by and large that we, the administration, are going the extra mile, not getting out of SALT II, even though the Soviets are clearly violating that treaty.

The compliance issue is one of the big issues hanging over arms control today. The Soviet Union—as this administration has reported to you and to others in the Congress—is currently, or has been, in violation of the Geneva Protocol and the Biological and Chemical Weapons Convention, the Limited Test Ban Treaty, the Threshold Test Ban Treaty, the ABM Treaty, the SALT II treaty, and the Helsinki accords and that is just about the whole kit and caboodle in arms control.

We have raised these questions with the Soviets. We would like to see their compliance record really be much better, obviously, and we have told them over and over again that to be serious about arms control is to be serious about compliance. Otherwise, arms control is not bilateral, but it is a form of unilateral disarmament. If one side adheres, like the United States, and the other side frequently violates, like the Soviet Union, then arms control loses the security benefits it has, and by and large will not be a useful instrument in the future.

I think the most serious violations were, of course, the Krasnoyarsk radar and probably the SS-25, and I will be happy to go into detail on those issues, if you would like.

Third, with regard to the offers that have been made external to the ongoing formal negotiations by Secretary General Gorbachev—a moratorium on nuclear testing, ASAT, nuclear-free zones and chemical weapons-free zones—there are certain things in common, Madam Chairman, with all these elements.

One thing glaringly in common is that they have virtually no effective verification provisions to any of them, so you are buying arms control on trust and really buying a pig in a poke if we go down this path. If I have heard any message from other committees with which I have had the privilege of dealing in the Congress it is that arms control has got to have effective verification provisions.

A moratorium on nuclear testing would just not have verification provisions. To get to Mrs. Holt's question, "What harm would it do?" I think that a temporary moratorium would give people the idea that we were really accomplishing something in the arms control realm; it would create all kinds of pressures to continue this Soviet-style moratorium longer and then we would get into the two problems that we have had with a comprehensive test ban: the one question on verification, especially low yields; and second, as you so eloquently said, Mrs. Holt, if you are continuing to rely on nuclear weapons for ultimate security of the West, then doesn't it make sense to be sure that there is some degree of reliability in this area.

So we have put those two caveats on a statement that a CTB remains a long-term goal of the United States, but not something realizable in the near term.

With regard to the President's certification to the Congress with respect to ASAT, the Congress has given us the standards, those standards are an ASAT arms control agreement that will be, (a) verifiable; and (b) in the national interest. Thus far, we have not identified any specific ASAT arms control proposal that would meet the two criteria that Congress laid out, although we are talking with the Soviets about the general subject of space weapons and defensive systems.

I think that in closed session, probably this afternoon, the negotiators could go into more detail with that because I would not want to get into the specifics of the negotiations in open session.

Last, with regard to the ratification of the Threshold Test Ban Treaty, a freeze on various systems and the House joint resolution on ratifying the Threshold Test Ban Treaty and the PNE Treaty, we have strongly opposed that resolution because we believe those two treaties which we have signed, and are adhering to, need to have better verification provisions negotiated before we request the Senate's advice and consent to ratification.

In fact, over the years, we and other administrations have expressed concern about Soviet nuclear testing activities as they relate to the TTBT.

To create a precedent of ratifying a treaty that the Soviets are likely violating even before ratification, I think, would be to set a very bad precedent.

Let me end there and spend time on your questions and thoughts on this.

Mrs. **Byron**. Thank you very much.

### PREPARED STATEMENT OF HON. KENNETH. L. ADELMAN

Mrs. Byron, it is always a pleasure to appear before the Arms Control panel to discuss the Administration's arms control program. One week from today the United States and the Soviet Union resume negotiations in Geneva on Nuclear and Space Arms. Today, I would like to address our approach to the third round and some of the fundamental issues which underlie this complex set of negotiations, and to brief you on the on-going Non-proliferation Treaty Review Conference, a forum whose objectives are equally critical to the national and international security.

As an Administration spokesman, I hesitate to use the somewhat trite phrase "realistic but hopeful" in characterizing our expectations for the third round of Geneva negotiations. Yet I believe realistic and hopeful is a fair statement about our approach to Round III.

Why should we be hopeful? First, the US continues to make progress toward completing a long-overdue nuclear forces modernization program without which there would be little incentive or reason for the Soviet Union to negotiate genuine arms reductions. Second, at this vantage point, it appears that the Soviet Union may have, for the first time in a number of years, a stable leadership without which it would be difficult to negotiate agreements entailing long term commitments. Third, the November meeting between President Reagan and General Secretary Gorbachev clearly represents an opportunity. Although there will be several important items on the agenda, it is obvious that arms control is among the key ones. We would hope that the Soviets will be prepared to join in injecting momentum to the arms control process.

Finally, it is time to negotiate. We are about where we had expected to be after only two rounds of negotiations of such importance and complexity. While there is little convergence of views, each side now has a better understanding of the other side's position. The President has provided our negotiators—Ambassadors Kampelman, Tower and Glitman—with the necessary flexibility and scope to negotiate an equitable, verifiable, agreement regarding force reductions—and I share the President's full confidence in our negotiators. We have specific proposals for significant reductions on the table—and have had for some time. On a number of occasions, the Soviet Union has publicly announced that it is prepared to offer proposals for radical reductions, but only if we will stop SDI research. That is an unacceptable precondition. We hope the Soviets will be ready for serious negotiating, both considering our concrete proposals and offering equally concrete proposals of their own, when the talks resume.

Given this basis for hope, why should we temper it with necessary realism? The Soviet approach to the negotiations is no surprise, but rather, it has confirmed our view of traditional, long-term Soviet arms control objectives. Their primary aims are to preserve substantial advantages in nuclear offensive forces fo them and to stop the US SDI research program, which could counter or negate many to their advantages. They have combined tough bargaining at the negotiating table with an extensive public propaganda campaign aimed at undermining support for US programs.

The centerpiece of this Soviet strategy has been their moratorium proposals that would lock in Soviet advantages in INF, ASAT and nuclear testing. They offer largely unspecified reductions later, and as noted, continue to link any progress in the area of offensive reductions to US acceptance of the Soviet approach to defense, space, and INF issues. This unconstructive approach with its unacceptable preconditions has been expressed in its most polemical form by Soviet allegations that the US is failing to honor the commitment in the January US-Soviet Joint Statement to address the complex of space and nuclear issues in their interrelationship, and thus is reneging on its commitment to prevent an arms race in space.

The accusation is clearly untrue. We fully recognize and are willing to discuss all aspects of the interrelationship between offensive and defensive forces, but do not believe that progress in one area should be held hostage to progress in other areas.

As we approach the new round of talks, it behooves us to keep the negotiation in perspective, to remind ourselves of the fundamental issues that underlie our current efforts. The January agreement with the Soviets to begin new negotiations at Geneva was a useful first step, but to consider it simply as a resumption of formal dialogue misses the real significance of the process that we have embarked upon.

The United States views the Geneva forum as one where we can address the full spectrum of means for enhancing stability and reducing the risk of war. Our highest priority is—and it should be—reductions in offensive nuclear forces. However, offensive and defensive systems are closely related and cannot be considered in isolation from each other.

For example, offense and defense were considered together in SALT I. At the time the ABM Treaty was negotiated, the United States believed that deterrence could best be assured if each side were able to maintain the ability to threaten retaliation against any attack and thereby impose on an aggressor costs that were clearly beyond any potential gains. That concept called for strict limitations on both the US and USSR strategic defensive forces, the maintenance of a balance between the two sides' offensive nuclear forces, and negotiated reductions on offensive nuclear arms to maintain balance and deterrence at progressively lower levels. Despite the exercise of restraint by the US in the 1970s in its programs, the Soviet Union failed to reciprocate. This has called into question the basic assumptions underlying our concept of deterrence.

In light of these and other considerations—particularly the horrendous threat posed by nuclear weapons—President Reagan decided that we should see a better way to assure credible deterrence over the long term. That is the purpose of the Strategic Defense Initiative—to determine whether new defensive technologies have potential for strengthening deterrence.

SDI is a long-term research program that is being conducted fully consistent with the ABM Treaty. It is not an effort to achieve superiority over the Soviet Union. In fact, one of our key objectives in the negotiations are to reverse the erosion of the ABM Treaty by seeking corrective Soviet action in areas of Soviet non-compliance and questionable compliance with that Treaty. Another long-term goal is to achieve deep reductions in offensive nuclear arms that will result in a more stable strategic relationship.

As we seek these near-term goals, we cannot allow Soviet negotiating tactics or public polemics to preempt our long-term ability to determine whether such defenses are feasible and whether they could contribute to a much more stable deterrent. At the same time, the President has made clear that any future decision to deploy new defenses against ballistic missiles would be a matter for negotiation.

This does not mean a Soviet veto over our defense programs. Rather our commitment to negotiation reflects a recognition that we should seek to move forward in a cooperative manner with the Soviets. We have thus offered to begin discussions even now in Geneva with the Soviets as to the implications of new defensive technologies, whether developed by them or by us, and how we might together manage a transition to be a more stable and reliable strategic relationship based on an increasing contribution of defensive systems in the mix of offense and defense.

Of course, arms control should play an important role in such a transition. For example, properly structured, cuts in offensive arms are not only worthwhile in their own right, but they could also facilitate the shift to a more defense-reliant posture.

Before negotiating such a cooperative transition with the Soviet Union, and throughout the transition period, we would, of course, consult fully and work closely with our allies. Such a transition would continue for some time, perhaps for decades, involving decreasing US and Soviet strategic and intermediate-range nuclear arsenals and increased contributions by defenses to deterrence. Ultimately, we believe this process could lead to a more stable world with the eventual elimination of all nuclear arms—an objective to which we, the Soviet Union, and all other nations can agree.

In addition to our bilateral talks in Geneva, there is going on today another forum in Geneva—the third NPT Review Conference—which shares this same vision of a world without nuclear weapons. The United States has always been a strong supporter of non-proliferation and the NPT. We are encouraging participants at the Conference to recognize the contribution of the NPT to the security of all nations. It has been instrumental in preventing further proliferation and—with over 125 parties—is mostly widely-adhered to arms control treaty in history. It has been a tremendous success.

I delivered President Reagan's message and the principal US address to the Conference. The President's message emphasized the importance of the NPT and reaffirmed the central arms control objective of his Administration to achieve substantial reductions in nuclear weapons. The President also emphasized the importance of U.S.-Soviet cooperation and indicated that he was looking forward to his November meeting with General Secretary Gorbachev.

The NPT is one area where the interests of the US and the Soviet Union coincide. Both countries have emhasized their respective arms control proposals. The first two weeks of the Conference have been characterized by restraint and cooperation. A senior Egyptian diplomat—Ambassador Mohammed Shaker—is President of the Conference. His efforts and those of his government helped significantly in promoting this positive atmosphere. The general debate has concluded and the committee work started this week.

As expected, many countries have supported a comprehensive nuclear test ban. The Soviets announced their proposed testing moratorium which is uninspected and unverifiable, and would put them in a position to breakout on an accelerted schedule as they did in 1961. In contrast President Reagan has made an unconditional offer to permit the Soviets to visit our testing site with their equipment to measure a US test to begin to lay the basis for verifying test limitations.

The concern by many countries relating to a CTB has not, however, diminished the recognition by virtually all speakers of the important contribution of the NPT to international security. Many countries also urged greater adherence to the Treaty, and supported broader coverage of international safeguards in nonparties to the NPT.

We know that the last two weeks of the Conference will be more difficult, as the effort begins in the Committees to examine certain issues in more detail. We hope that the spirit of restraint and cooperation will continue, and that the Conference outcome will further strengthen the NPT.

Mrs. BYRON. Let me start off with a couple of questions. As I mentioned in my opening remarks, the President has submitted two reports on Soviet noncompliance. Could you go into that in more detail? Have the Soviets agreed to any corrective action? Has it been acknowledged by the Soviets that we have even made a statement in that area? Do you see any potential corrective actions as a result of the negotiations within the Standing Consultative

Commission? You mentioned the phased-array radar and I think we could in open session go into that in a little bit more detail.

### KRASNOYARSK RADAR

Mr. **Adelman**. Let me start with that because, as John Mitchell used to say, that is the big enchilada.

Mrs. **Byron**. After verification.

Mr. **Adelman**. You have a difference. The Krasnoyarsk radar shows the difference. We can verify the provision of the treaty saying early warning radars should be on the periphery facing outward. We found the Krasnoyarsk radar not on the periphery and not facing outward. It is 4,000 kilometers from the border it is facing, 700 miles from the Mongolian border, which it is not facing.

By no stretch of the imagination could it be considered on the periphery facing outward. From the arms control point of view, what is most disturbing about the Krasnoyarsk radar is that it is a long lead-time item. If the Soviets were going to acquire a nationwide ABM territorial defense—that is the one whole category that has been clearly outlawed by the ABM Treaty—phased-array radars of that type would be the long lead-time items needed to start the process of building that territorial defense.

It is most disturbing because the radar was ordered for construction and probably started construction in the seventies, the same decade in which the Soviets signed the ABM Treaty. This is a stunning development because the Soviets certainly knew that we would find the radar.

It is several football fields large. They certainly knew that by no stretch of the imagination could we consider it anything else but a violation, but with seeming disregard, or callousness, or carelessness, they went ahead with this radar, so it is a clear violation. It reminds me of a passage in the book by the Soviet defector who used to work at the United Nation, Arkady Shevchenko. He has a wonderful paragraph in it that states that the at the same Politburo meeting where they decided to sign the Biological Weapons Convention [BWC] in 1971, during that same meeting, they decided to go ahead and produce biological weapons which were in direct violation of that convention.

So, according to his account, it is almost like agenda item 1 of the meeting was to do away with any kind of research for biological weapons and sign the BWC; agenda item 4 of the same meeting was to go ahead and do research in biological weapons. And that kind of thinking is reflected in the construction of the Krasnoyarsk radar.

Mrs. **Byron**. Let me say that this committee has looked at that issue; the Administration has been looking at that issue. We have both discussed needs to take proportionate steps with regard to those violations. Do you find that currently any steps are being considered at this time?

Mr. **Adelman**. We have discussed at great length with the Soviets our problem on the radar. In fact, it is interesting that during the time that this issue came up in the summer of 1983 we were doing the first draft of the President's report, which as you mentioned was submitted in January 1984.

We in the Arms Control Agency were doing that. It was interesting that the big debate among the professionals, our very good professionals in the agency, was whether or not to include as a possible Soviet reason that the radar was a space tracking radar.

We had not talked to the Soviets about the issue because they had not agreed with our request to have a special meeting of the SCC, so we did not know what excuse they were going to give for the radar.

Some experts in the agency thought that saying that it was a space tracking radar was such a preposterous notion that we should not include it in our report because the Soviets could give more convincing reasons. Then the Soviets decided to give that as a reason. It shows that we could have written a better brief for them on the Krasnoyarsk radar than they wrote. They picked a pretty lame excuse.

There has not been any significant movement on that issue from the Soviets since that time.

Mrs. **Byron**. Mrs. Holt.

Mrs. **Holt**. Thank you, Madam Chairman.

I am concerned about some of the attitudes that we see here in the Congress. We have a couple of bills kicking around. House Joint Resolution 3 which came out of the Foreign Affairs Committee is stronger than simply a sense of Congress, and would require to some extent the President to immediately begin negotiations for a comprehensive test ban. We also have H.R. 3100 which is the old freeze job. Yesterday the oversight people for the negotiations met with our negotiators. Some of the Members of Congress were urging Ambassador Kampelman to make overtures to the Soviet Union, offer some cessation of research in SDI. They felt that we were not approaching the negotiations in the proper way; that we should make a good faith offer to give up another B-1 or something like that and see what they would do in return. Talk a little bit about how you feel our actions here affect the possibilities of the negotiators.

### CONGRESS' EFFECT ON NEGOTIATIONS

Mr. **Adelman**. Well, it is just a fact of our governmental system and our democratic life. We really wouldn't want it any other way, but you have to realize that the kind of pressures that are exerted on our negotiators and negotiating process are extremely one sided, that there are no compensating pressures on the Soviet side which is why the Soviets can have grand proposals and set dates for results in arms control.

They feel none of the pressures, from their public, or from their parliament, or from the press, that we have. I have often thought about your question, Mrs. Holt, and thought to myself what it would be like if you had a labor negotiator negotiating with a business and he was trying to get $5 an hour for his workers. Some of the locals had taken a vote and wanted $3.50 an hour. Some of them didn't want the 3 weeks' vacation that he was trying to negotiate for and they were little by little trying to eat away at all the kinds of proposals he was trying to get management to agree to.

Of course, nothing like that ever happens in labor negotiations, but if it did, it would obviously start undercutting his negotiations.

In that analogy, the management can well realize what locals are doing but by and large labor negotiators are helped by the staunchness of the locals behind them rather than by flimsiness in their support.

In arms control negotiations, I think experience will show it is almost never that you get serious pressure from the Congress to be tougher in dealing with the Soviets. I say almost never. I think the pressure is always to give up something to create a better environment. What can we give away to have a successful summit? If the name of the game is gutting American programs, then we can do that pretty easily. We can do that with or without the Russians. Obviously if we start, and the Congress starts, to cut programs that are under discussion with the Soviets, then they can get something free for which they don't have to give up anything.

Mrs. **Holt**. Certainly that is my feeling about it. I think that our lack of patience and our desire to create an agreement simply for the sake of the agreement has been working to our detriment in the past. You said you would talk a little more about the SS-25 if we wanted you to. Will you?

Mr. **Adelman**. Sure. I probably get asked when I go around the country more than anything else, is there going to be an agreement. It is such a funny question because it implies that any agreement is OK—no matter the terms. I have told people, and I firmly believe, that arms control by and large has legitimized what the Soviets want to do anyway and that if we want another arms control agreement that results in a big buildup of Soviet forces, such as in SALT II—they have added 4,500 ballistic missile warheads—we can have that kind of agreement tomorrow.

I often wonder myself what it would have been like if my predecessor testified on SALT I, stood up to this committee and said:

> Members of this committee, let me just tell you that I think SALT I is a very good proposal.
>
> I should just tell you that over the next 10 or 15 years under the terms of SALT I, the Soviets are going to add 8,500 ballistic missile warheads.
>
> I am going to tell you that under the terms of SALT I, the Soviets are going to have five new generations of land-based missiles. I am going to tell you that under the terms of this agreement we are going to have three new bombers on the Soviet side. I am going to tell you that there is going to be X number of new SLBM types as well as numbers.

You would have sat there and said, "Ye, Gods, what does this agreement do?" And during SALT II, if the testimony has been under this agreement, "by 1985, the Soviets are going to add 4,500 ballistic missile warheads to their arsenal, have new type missiles, et cetera."

Getting back to your question, Mrs. Holt, the SS-25 is very disturbing because it is a prohibited second new type Soviet missile. They designated the SS-24 as their one permitted new-type missile and again, with seeming disregard for how we would take this violation, they went ahead and tested something that the U.S. Government agencies involved have been unanimous in finding a clear violation.

Mrs. **Holt**. Thank you.

Mrs. **Byron**. Mr. Stratton.

Mr. **Stratton**. Thank you, Madam Chairman.

Mr. Adelman, let me welcome you once again before this subcommittee. I appreciate your recognition of our valiant efforts in trying to end the arms race back in 1982. In fact, I was surprised to see you walk in because it was my impression that you were either already in jail or soon were going there because of what has been charged a very serious violation, possibly with implications of impeachment of the President of the United States, to have advised Congress that there was going to be a test of the ASAT; but presumably the conditions that the congressional resolution had provided had not been fulfilled, and I am glad to see that you are out on parole at least for some time.

Mr. **Adelman**. For this hearing.

## ASAT ISSUE

Mr. **Stratton**. What troubles me is that this ASAT thing is the number one issue on arms control, at least at the moment, and I have never been able to understand why the exponents of arms control seem to feel that there is something immoral if the United States should get ahead of the Soviet Union.

Mr. Brown, who was one of the major arms control advocates, has been very strongly opposed to our undertaking a test of our own ASAT because that would mean that we were ahead of the Soviet Union, and why is it that it should be bad for us to be ahead of the Soviet Union?

I thought that in our carriers we were hoping to have carriers that were much more capable than the Soviets, nuclear submarines that were much more favorable, and yet somehow in this particular case we are supposed to be behind the Soviets, and if we should get ahead of them, that is somehow bad. I don't know whether you can answer that question, but it has been perplexing to me.

Mr. **Adelman**. I think that the answer to your very perplexing question is basically hard to find. History shows that we have had a period of U.S. strategic and military superiority from 1946 to 1967, 1968, 1969; there was no aggressiveness by the United States during that time, there was no taking of territory, there was no kind of expansionist foreign policy, there was an attempt by our country for a flourishing of freedom and for peoples choices around the world.

We have not lived in a period of Soviet military superiority and if indications—Afghanistan, and Eastern Europe and the Northern Island in Japan—give us any light into what would happen, it would not be such a pleasant world for us or for those who love freedom.

So to think for a moment that we would be responsible, as public officials, to allow the Soviets to get strategic superiority or military superiority is to just lose all sense, if you ask me. It would be the most irresponsble thing we could give to our future generations, to hand them Soviet superiority.

On the ASAT issue itself, I can't remember many of your colleagues, Mr. Stratton, protesting when the Soviets started testing their ASAT. I can't remember the kind of excitement that we hear today when the Soviet program gets going, and it does seem to me that it gets back to what President Mitterand said about INF's a few years ago when he asked the simple question, "Why are all the Euromissiles in the East and all the protesters in the West?"

So that this kind of excitement comes up when the United States tries to have its test of an ASAT system, when the Soviets have had an operational system since 1971. I think that the plea there is to have a moratorium which would lock in Soviet superiority. The Soviets would like to have superiority in this realm as in every realm, and any time you have a moratorium the Soviets will have a good negotiating climate, because they will just love it.

### MX MISSILE SYSTEM

Mr. STRATTON. As you know, the decision made in the conference report on the fiscal year 1986 Defense Authorization Act limited and capped the MX missile system at 50 weapons. I wonder if you could give us any idea what that kind of a decision generates in terms of Soviet perceptions? It was a very supportive President on arms control, President Carter, who said that we needed at least 200 MX missiles for the system to be credible.

President Reagan reduced that to 100, and now we are down to 50. What does that do to us in our negotiations in Geneva or our negotiations with Mr. Gorbachev if that summit meeting comes off?

Mr. ADELMAN. I think that gets back to the point I was making a few minutes ago and that Mrs. Holt was making—that if you hand the Soviets strategic superiority by our unilateral actions, then they are never going to achieve strategic parity through negotiations. We are never going to win at the negotiating table what we hand up and yield up unilaterally. I think it was much better said by my old friend and, now I am happy to say, colleague, Max Kampelman who said when we give up programs like this, the Soviets never see it as a sign of good will, they see it as a sign of lack of will.

Mr. STRATTON. Mr. Mavroules, who was one of those who was responsible for pushing the program from the 40 that the House had agreed to up to 50, also indicated that he recognized that if the MX was to be credible it needed additional weapons to be tested from time to time to make sure that the system really works, and he was agreeable to requiring those additional test missiles.

If we should be short of what we needed in a period of tension or of actual combat, would it be possible to use those test missiles as part of our arsenal?

Mr. ADELMAN. I don't know the answer to that, Mr. Stratton. Let me say that all these questions on Soviet attitudes toward this or that make me think that maybe at the witness stand should be my friend from the Soviet Union who is back there who seems to go to all the hearings that I appear at.

I guess I keep a few guys from the Embassy employed full-time on my testimonies; but his presence does show a tremendous asymmetry in what we are dealing with—when we have an open society on arms control and he can go to all the hearings and get all the studies; and where we really have a black box as far as Soviet programs go, and Soviet intentions and Soviet plans on arms control.

Mr. STRATTON. Thank you.

Mrs. **Byron**. Mr. Badham.

Mr. **Badham**. Thank you, Madam Chairman.

Mr. Adelman, it is always a pleasure to greet you here. I got the thought after your last comment about the presence of the Soviet Union here in our committee room that you are beginning to act human. I think you do a magnificent job as far as you are able and I consider you to be extremely able, but I don't enjoy your job very much at all.

Mr. **Adelman**. I don't enjoy my job either.

Mr. **Badham**. I don't see how you can do it really.

Mr. **Adelman**. I had a happier life at the United Nations, if you can believe that.

### SOVIET PLEDGES

Mr. **Badham**. Don't run for Congress. That is worse. The Soviet Union of course has pledged no first use of nuclear weapons. So should we really care whether or not they have more warheads and missiles than we?

Mr. **Adelman**. We really care that they pledge that. You have to look at the record of Soviet pledges over the years. They signed nonaggression treaties with Afghanistan, with others. Once you get into an unverifiable, unenforceable agreement with the Soviets you better watch out. The history of the Soviets caring about those kind of questions is not a bright history, so when they say no first use of nuclear weapons what they want to do is to erode free societies from having the web of deterrence that we have had.

Since 1946 the Soviets have been superior in conventional arms in Europe, the central front. We have said that the deterrence is a spectrum on the conventional level, the tactical nuclear level, the theater nuclear level and the strategic nuclear level. These are all related and therefore we were going to come to the defense of Western Europe if attacked and in whatever way we saw fit.

Mr. **Badham**. Now, you have mentioned the statement about if we should give the Soviets strategic superiority. Have we already or have we already not?

Mr. **Adelman**. I don't think we have. I think that what we have to watch out for today is what is going to happen in the future. This panel and your full committee and the whole U.S. Congress is not voting on the military systems that President Reagan will have as tools to use. What you are doing and what he is proposing are budgets for future Presidents. Previous Presidents have given him the tools he uses today. He was quite disturbed—at the beginning of President Reagan's administration—when he came into that office, the Soviet Union had an open-production line in all three legs of the strategic triad—in Khrushchev's phrase cranking out missiles like sausages—while the United States, when President Reagan took office, had no open-production line in two out of the three legs of the strategic triad.

We had no open production line on heavy bombers, we had no open production line on ICBM's. That kind of trend over the years has got to hand the Soviets strategic superiority. Thank God we have had a strategic modernization program to restore that. We have the B-1 and we have had the MX, although 50. We are looking at other remedies in the ICBM's, the Trident is still on schedule. Cruise missiles have come along.

But I think that is essential to keep the deterrent force going and to provide incentives for arms control. It seems to me with the defense plan of the previous administration that, although as Mr. Stratton says it was certainly an administration devoted to arms control, it was really undercutting arms control by the lack of any kind of incentives.

Mr. **Badham**. Throughout your formal statement you used references to trite phrases and polemics. In your impression does it make your job harder to sell at home and abroad or easier if, assuming that the Soviet statements are polemical in nature, that they do play pretty well in the American press?

### SOVIET CHARM OFFENSIVE

Mr. **Adelman**. They do play somewhat well and I think that Mr. Gorbachev is on a charm offensive. I think, however, that they are able to do things that we just simply cannot do because of our political system and I am not saying that at all critically to our system, but it is just a factor. We cannot go and just give grand meaningless pronouncements in arms control that have nothing really of substance beneath them, because we will be hauled up for congressional testimony, the press will want to see what is behind it, and the allies will want to see what is in it. That is a basic asymmetry.

They can say all kinds of things with disregard. I think that the Soviets today are following Lenin's maxim that what happens outside the negotiating room is far more important than anything that happens inside the negotiating room. They are trying to turn this charm offensive into working our congressional system, working our allied system to really go after and gut democracy.

Mr. **Badham**. Thank you. Again it is a pleasure. Thank you for being here.

Mrs. **Byron**. We have a vote on the floor. I think if everyone agrees, we will take about a 10-minute break, go vote and come back quickly.

Mr. Ray, you will be on next when we get back.

[Recess.]

Mr. **Ray**. In the absence of Mrs. Byron, I think we will just proceed, and since I am up next, I would like to say welcome, Mr. Adelman, to this hearing today and your testimony—I just apologize for being late—but I enjoyed, just finished reading through your opening statement, which is very effective.

I notice that you are expecting that the meeting with the President and the General Secretary may produce some positive indications, particularly in the areas of arms control. Can you elaborate on that just a little bit? Are you expecting some things on the agenda that will encourage all of us?

Mr. **Adelman**. Yes, I think we can expect that the President will convey to Mr. Gorbachev: His sense of how we have to move the arms control process forward; that the Soviets should stop their propaganda assault which is not matched by any seriousness in the negotiating room—I think that the real place where we can do business in arms control is in the negotiating room in Geneva; that the Soviet proposals by and large have been tailored to a propaganda offensive rather than to moving the process forward; and that we want to cut production in offensive nuclear weapons.

Second, I think Mr. Gorbachev can get a sense from the President of how the President feels about SDI as a research program that offers the possibility to make a much safer world, and to get away from this idea of two scorpions in the bottle or two people with guns held at each other's heads.

Mr. **Ray**. Yes. I noticed you have made very fine comments about Ambassadors Kampelman and Glitman and your confidence in them and so forth.

Mr. **Adelman**. Extremely much. I have known Max Kampelman—we were colleagues on various activities—for a good number of years. In fact, after I was named, nominated, confirmed as Director of ACDA, I started a little outside group that met some Saturdays to talk about arms control—just to get advice from those I consider the wisest people around town. Max Kampelman was among them, and he spent some Saturdays with me and with others in the agency and outside, giving advice on these issues. I valued it and also found him terrific.

Mr. **Ray**. While we are very interested in this panel in arms control, and the ramifications of it and so forth as important, I myself have a rather difficult time in talking to our Members of Congress, Members who don't have that same interest, and to my constituents, as soon as I get into arms control their eyes begin to kind of glaze over to a degree, and so we are looking forward to these dynamic new people in their negotiations and talks and so forth, and in bringing some strong interest that we can raise in our constituents on arms control—our constituents at large.

## NEW STRATEGIES

Do you see any new strategy—I know you can't talk in detail about this—do you see strategy developing which might be something we can use in our goals on this panel to keep people informed, keep the commitment alive, the interest alive and negotiations strongly supported? Do you see something coming down the pike maybe we we don't know at this time?

Mr. **Adelman**. I guess, Mr. Ray that I have found myself that the interest in arms control is extremely high around the country and indeed around the world. Knowledge about arms control is extremely low. I have not known a subject where people feel so passionately and yet spend so little time learning about the issue, as arms control. It reminds me of a story that Samuel Johnson once reviewed a novel and met a fellow on the street the next day, who said, "Dr. Johnson, that novel that you reviewed—you gave it a glowing review and it is just a terrible, terrible book." Samuel Johnson replied: "Oh, my lad, I would much rather praise his books than ever read them."

In arms control there is a similar kind of feeling that I see at this time. People would much rather talk over the issue than learn about it. So I look to this committee, as I look to all serious Congressmen and Senators, to infuse the emotion with some kind of knowledge, with some kind of sense, with some kind of historical perspective in terms of the issues we were discussing this morning—how administration after administration wants deep reductions and arms control and the Soviets have really never agreed to that.

How administration after administration wants Soviet compliance. That has not taken place.

How we have tried to change the military situation through arms control and the Soviets have not agreed.

I think those kinds of steps and knowledge would move the debate over whether there is going to be arms control agreement or not going to be arms control agreement on to a more cerebral plane.

### CHEMICAL WEAPONS BAN

Mr. Ray. Secretary Gorbachev this week, in the last several days at least, said that he would give consideration to a chemical free zone in Europe. Is this more of the same?

Mr. Adelman. This is word for word the same as happened a few years ago. It surprises me, Congressman Ray, how you can take a press release from a few years ago, dust it off and issue it again and get a third page story in the New York Times. It just stuns me. You try to do it sometime in your District. I will bet you won't succeed. But the Soviets do it and they succeed just find.

Mr. Ray. How would you improve on the Soviet proposal?

Mr. Adelman. Sure, we can improve it, we can improve on it by having a worldwide ban on chemical weapons and that is why you heard from Ambassador Lowitz on those negotiations, and we consider those negotiations extremely important. While there was some modest progress in this round on banning chemicals, by and large the Soviets have been stonewalling. They would like a chemical weapons free zone in central Europe, knowing that they could bring in chemical weapons in one-half hour to flight at any time, and knowing that we could never find a specific chemical weapons, free zone or not. It is an old press release that they have taken out of the drawer and, blown off; and, people in our press think it is worthy of page 3.

Mr. Ray. My final comment along that line, do you speculate that the fact that we have made a little bit of progress here in the Congress on binary weapons might have backed that up as the answer to that?

Mr. Adelman. Yes sir, I think it is a necessary but not sufficient ingredient for the Soviets to start negotiating seriously on a worldwide ban, and we have made it emphatically clear to them that we will get on and eliminate chemical weapons from Earth, and Sam Stratton and others know that I spent most of my time at the United Nations working on this very issue because when I look at history, and in the future, I think to myself how many people will die of nuclear weapons over the coming years, and the answer is not many. I don't believe any.

But how many people will die of chemical weapons? Many people in the Third World unless we get a handle on this issue. Chemical weapons are the poor man's weapon of mass destruction, and the poor countries weapons of mass devastation. So they are particularly horrendous, as we all know. In Southeast Asia the yellow rain, Soviet chemicals given to the Vietnamese, resulted in people's skin melting off, blood flowing out of all the their body openings, and people choking on their own blood before they died.

I went with a team, after going to China, up in northern Thailand to a refugee camp and talked to people whose families had been exterminated in this manner. It is not a very pleasant way to go, it is painful, it is just vile.

Since that time, the Iraqis have definitely used chemical weapons. There are more and more countries out there shopping for chemical weapons. The number of chemical weapons states has gone from 5 in 1963 to 14 to 16 today. I think it is a big problem that we should address, trying to get a total ban on chemical weapons and short of that, to try to persuade the West to have a nonproliferation effort on chemical weapons to stop the spread of them. We have been making progress along those lines.

Mr. **Ray**. Thank you so much. We really appreciate your being here today, this morning, and I guess all of my comments are based on the fact we are trying to find and work with you in a positive way to project hope and interest in our constituency that they support us and you in negotiations.

Mr. **Adelman**. Thank you. That comes through and we appreciate it.

Mrs. **Byron**. Mr. Courter.

Mr. **Courter**. Thank you very much. It is a pleasure to be here to listen to Mr. Adelman. I have a number of questions in a number of areas if you could just talk about them. I had the opportunity to talk with Ambassador Gerard Smith in my office yesterday. He wrote an article and I disagreed with it. I wanted to straighten the record, so we had a chance to talk about a number of things, one of which was about the Krasnoyarsk radar—I would like your clarification of your statement about those things.

He indicated to me that the Krasnoyarsk radar would not be a Soviet violation. We won't know until it is turned on. He also said that the United States has two phased array radars that, although not oriented totally outward, are on angles so they would be technical violations of the treaty and I would like your comments on that.

The President proposed to the Soviets that they send technical observers, as you know, to a nuclear test and I think I know, but I am wondering if you would just give me your thinking as to the reasoning behind that.

### TREATY VIOLATIONS

Finally, I noticed that you indicated the importance of having a comprehensive treaty prohibiting chemical weapons, and I have always been concerned about verification of arms control agreements, as you know, and it seems to me, in my mind—and the reason I am asking you is to set me straight—is that, is it consistent to have a position like the United States has, of advocating a total ban on chemical weapons and at the same time we are not quite ready to have a comprehensive test ban treaty because we can't verify a nuclear explosion. It seems to me that if we can verify the existence of chemical weapons we can certainly verify a nuclear explosion.

Mr. ADELMAN. A good point. Thank you, and thank you for your help over the years on many of these issues.

First, on the Krasnoyarsk radar. It is our legal opinion that—and this is not contradicted by any agency of the Government—that the Krasnoyarsk radar is a violation because of its location and it does not have to be turned on to be a violation, at all, because the ABM Treaty states that you cannot have a radar of this type located anywhere else but on the periphery facing outward.

This has been an issue that I have been going back and forth on with the group that Congressman Solarz organized—I think it is a noble effort. We agree on very few issues but on this one Solarz wrote to Mr. Gorbachev saying that the radar was a very serious issue on violations. However, Congressman Solarz was of the opinion that the Krasnoyark radar was not a violation until it was turned on.

We wrote Congressman Solarz a letter saying that in our legal opinion, it was not a question of when the radar was turned on, it was a question of the location and it is a violation today as a result.of that location. I will be happy to provide that information to this panel.

Second, on U.S. radars, there has been this claim made by my predecessor, Gerard Smith and others. Let me say, in simplest terms, if we were violating the ABM Treaty, or any treaty in the world, you wouldn't hear whisper campaigns about it, you would see front page stories about it. It would be on the cover of most news magazines; it would be the subject of tremendous congressional testimony; there would be waving arms around and everything else. It wouldn't be a whisper campaign, or just rumors, on it at all.

We have built these radars with the Treaty clearly in mind and clearly realizing: (a) The United States in any administration abides by the commitment that it makes—that has been steady throughout history, and (b) that any administration that doesn't abide by the commitment of the United States will certainly be found out pretty damn quick and so that you will get this self enforcing mechanism. The details of that radar I will be happy to supply. I have looked into that matter myself and I don't think it is even a close call. I am interested that some people in the United States make a bigger issue of that kind of situation than do the Soviets themselves. But maybe they will make a bigger issue if the people in the United States keep talking about it.

Third, on nuclear testing, we do see that the problem on the nuclear testing issue was twofold, the verification problem and the problem of reliance on nuclear weapons for the ultimate security of the West.

On the verification issue, we thought the best way to move the process forward was to have an exchange of visitors, of Americans at Soviet tests, and Soviets at American test sites. What this would enable the United States to do is to calibrate the seismographic data measured around the world, see how accurate it was in terms of what the Soviet test sites actually are seismologically.

In simple terms a speedometer on a car that can tell you 60 miles an hour, 50 miles an hour, whatever speed it is moving. That speedometer may work very well but we need it, when the car is finished production, to be calibrated on a treadmill that it goes exactly 60, so that you can make it clearly on 60 when you know the speed is 60; then you will know that speedometer works fine. The same is true with a thermometer in the House. Once you do that calibration, your instruments will be accurate.

We have never gotten any information directly for calibration of how accurate our seismographic data is. Consequently, we have been going back and forth over the years saying that the Threshold Test Ban Treaty and Peaceful Nuclear Explosion [PNE] Treaty cannot be verified to closer than a factor of two. If a test is 150 kt, it could show up on the monitors at 75 and it could show up at 300.

So what we wanted to do is to have an exchange of visitors. To be more forthcoming yet, this year, the President offered to have the Soviets come and start the process by visiting the test site in Nevada. For the life of me, spending many hours thinking about this question, I cannot imagine what the down side would be to the Soviet Union doing this, but the Soviet Union has not accepted and in fact, refused; and there we sit.

On the question of chemical weapons and the comprehensive test ban [CTB] I guess the answer is that we are willing to have for chemical weapons verification, an anytime, anywhere verification provision. Where we, the Soviet Union, or any country suspect chemical weapons, we would open up that facility to show that we had no chemical weapons and would expect the Soviets to do the same.

We do not rely on chemical weapons for the ultimate guarantee of our security as we do nuclear weapons. So that is a very big difference between the two. It goes back to the point that Congresswoman Holt made so well: That, when you have nuclear weapons as ultimate guarantor of freedom of the West, you have to be very attentive to that until the time nuclear weapons are done away with. We hope very sincerely that the President will get to realize his dream at some point that nuclear weapons are no longer on Earth, but we are quite a ways from that right now.

Mrs. BYRON. Mr. Courter, do you have any further questions?

Mr. COURTER. Yes, if I have a moment.

Mrs. BYRON. We are going to go a second round.

Mr. COURTER. I will wait for the second round.

Mr. ADELMAN. I have never seen him without questions in my life. This will be a first.

Mrs. BYRON. I thought I would ask him. I knew he might have some more.

Let me touch on an issue that has been quite prominent in the media. I think Congressman Stratton touched on it a little while ago and the fact he is glad that you were not behind bars today and that is——

Mr. ADELMAN. He didn't say that, Madam Chairman, he just noted the fact that I wasn't behind bars. I don't want to put any words in his mouth.

Mrs. BYRON. In your response to the furor that we have seen in some quarters of Congress caused by the go ahead on ASAT testing by the administration, last year we tried very diligently to get an amendment—I was the one that was in charge of that amendment—to give us the authorization to test the same number of tests that the Russians have done on their ASAT's.

Do you feel that we currently, had that amendment passed last year, have already completed the tests that are initially projected for this timeframe? There has been an awful lot of discussion going on about the timeframe now, is it tied in with the talks coming up in November, or is it just a period of development whereby it comes by time to do the tests?

Mr. Adelman. Let me say several things on that, if I may, Madam Chairman. First is that the administration is certifying in good faith to the Congress—and when we issued that certification, I think we made it quite clear how this test meets the certification requirements of Congress.

### ASAT PROGRAM

Second, I would note that the ASAT Program is a program that was first proposed in 1976 and then really proposed in a serious manner from 1977-78 during the Carter administration. Congress has supported the program year after year; so we should not get the idea now that a group of individual Congressmen, who are trying to kill the program, are any kind of example of the will of Congress.

Third, I think that it makes sense for the Congress to support this program because we do not want to lock in a Soviet monopoly on ASAT's any more than NATO wanted to lock in a Soviet monopoly on SS-20's and that kind of weapon system. I think any time you lock in a Soviet monopoly you are only asking for trouble in terms of world stability and security.

Lastly, let me say, now that I am on the test program itself, that this is not the speediest test program that has ever come about for a military program. As I said, the funding was first proposed in 1976, really pushed for in 1977. The first tests were held in 1984 and here we are almost 10 years after the program is first proposed with the third test.

We do not change the timetable of the test program in any general sense because of arms control or any other considerations. The program was going to test against what are called ITV's—instrumented test vehicles, and against old satellites and that mix was changed so that one test that was going against an instrumented test vehicle, one of those balloons, has been changed to an old satellite. That doesn't change the nature of the testing program one bit.

Let me end up by saying, Madam Chairman, that I think it is a bad idea to negotiate with the Soviets and to give all kinds of things in anticipation of what the Soviets might do at the negotiations themselves. I think that what you are doing is giving away bargaining leverage by doing that. I don't think it is ever good to negotiate and to give up, time and time again, while you are negotiating exactly the subject that you are negotiating over.

Mrs. Byron. I think we saw that with the negotiations over the Pershing missiles, at which time they had on the drawing board for a 7-year timeframe for deployment. As it came to the time to be deployed, that was the time at which time the Soviets said, hey, wait a minute, if you don't deploy them we will talk about it seriously. I think the same thing is true in this program.

In our opinion, do you feel that the Soviets all of a sudden are dragging behind in the ASAT research or in their system?

Mr. **ADELMAN**. No; I think their system is a system that has operational capability and has had operational capability since 1971. I think their system is a system that is based on 1960's technology, just as our system is based on 1970's or 1980's technology.

Mrs. **BYRON**. They have an existing system?

Mr. **ADELMAN**. They have an existing system and that is worth something in this business. We have plans for one. We have a test program to eventually have one. But as I say, if you look at the test program it is not the quickest moving program in the world. It is now almost a decade old.

And second, their system, although more primitive than our system would be, still has an operational capability and still, according to the best estimates we can come up with, would be quite effective in hitting valuable satellites of the United States. This is important because it could result in serious damage in time of conflict to our capabilities.

Mrs. **BYRON**. Let me talk a little bit about the SDI. In my mind, I find it very difficult to go from square 1 to an active SDI without an intermediary step. Is ASAT an intermediary step toward an SDI concept or deployment?

Mr. **ADELMAN**. No; I think that while it is true that there is some technology common to ASAT and to SDI, by and large the programs are designed to do different things and will have different capabilities. Let me remind you, once again, the ASAT Program was first started in 1976. This is 7 years before SDI was even conceived by President Reagan, so in no sense can you say that the ASAT Program is a subterfuge for the SDI Program.

Second, the capabilities would be quite different and a system to destroy a satellite in space is quite different from one for destroying a reentry vehicle—although, as I say, there are some areas of overlapping capability.

Mrs. **BYRON**. Mr. Gorbachev has recently stated that he feels that money for SDI is being spent on things other than on research. Do we have a differentiation in our view of what research is and the Soviets have a different view of what constitutes research?

Mr. **ADELMAN**. That is a very complicated area and it is one that I am going to take a pass at this time because we have been discussing this matter in private with the Soviets and I would like to keep it on track.

### ABM TREATY

Mrs. **BYRON**. How about in regard to the contention that the program violates the ABM Treaty?

Mr. **ADELMAN**. That is preposterous and it would be preposterous to ever claim that the SDI violates the ABM Treaty. We have designed the program to be in conformity to the ABM Treaty. I know firsthand that there were some things that the technicians would have liked to have done. They were just not allowed to be done, in order to keep it in conformity to the ABM Treaty. Let me assure you, Madam Chairman, not only would we never go that route, because the President made it very clear that we are to stick with the provisions of the ABM Treaty, but second, that, if we went that route, you would know about it the morning after, because of, as I say, our open society, our open press, and our open congressional investigations.

Mrs. **Byron**. Mrs. Holt.

Mrs. **Holt**. I have no further questions.

Mrs. **Byron**. Mr. Stratton.

Mr. **Stratton**. In connection with that question of whether it does or does not violate the ABM Treaty, I was around when the ABM Treaty was signed and I was one of those who thought it was a mistake when we backed off of an antiballistic missile. My general recollection was that the ABM Treaty said that you could have one site at your capital and you could have one other site, and the Soviets set up a substantial site around Moscow and somewhere else, and we decided not to have any. But when SDI came along, there were things quoted in the press that I never had even heard about in the ABM Treaty—items that were responsible for this charge that the SDI was going to violate the ABM Treaty. Where did these subtleties come from?

Mr. **Adelman**. They are not subtleties, they are just a campaign against SDI. What those people are saying is that—or let me be clear—what the Soviets have been saying is that there is research with an intent to do one thing, and research with intent to do something else. They have research only with a good intention. We have research only with a bad intention.

The ABM Treaty is quite clear in one respect, research is allowed and we never have gotten into this business with the Soviets, nor should we ever, of banning something to do with intentions. Intentions happen in people's minds and we cannot verify what happens in people's minds. What we are saying is that research in this area is allowed, and has been allowed. That was clear from the ABM Treaty but the Soviets have been taking a different tack. You shouldn't be surprised at this. The Soviets will take any tack that they can to gut SDI.

Mr. **Stratton**. That seems to be quite clear. It must be good because it has them really worried.

Mr. **Adelman**. They are all tripped up, Congressman Stratton, on their propaganda campaign and they have a little trouble with it. On the one hand they say SDI is going to be useless because they can have countermeasures and steps that easily thwarts defense. On the other, they say it is exceedingly dangerous and destabilizing. If it is going to be useless it is not going to be destabilizing.

They also say they have been involved in research for a good number of years, but that it is in conformity to the ABM Treaty—but no, we cannot do that kind of research because it would break the ABM Treaty. So they really are all over the place. I think the big picture is that they would like to see us stop the research, and stop doing something that is literally allowed by the ABM Treaty; namely the research on SDI, while they continue to do something that is clearly in violation of the ABM Treaty; which is the Krasnoyarsk radar.

Mr. **Stratton**. Let me ask one other question, if I may, and this may be classified, but I would like to get your response.

We have had a tremendous flurry of activity on the part of the new Secretary General Gorbachev. He first presented the interview with Time Magazine and then he later appeared to have charmed a delegation from the U.S. Senate, although it probably doesn't take too much to charm them. But we are being accused in the press that Gorbachev has got a whole fixed agenda of proposals, we don't have anything. On broad shoulders rests the responsibilities for coming up with a comprehensive program that will floor him. Have we got that?

Mr. **Adelman**. We have that.

Mr. **Stratton**. Underway?

Mr. **Adelman**. And we have that and it has been underway. The difference is that our proposals are serious and therefore; they have more details and more of the kind of meat of the substance than these grand, sweeping moratoria you always hear about. What we want to do is reduce nuclear weapons. We both have about 8,500 ballistic missile warheads. We want to get them down to 5,000 on each side. That is a one-third reduction.

We want to eliminate the entire class of weapon systems, INF systems, or at least get the numbers down to the lowest Soviets will let us get them down to.

We want to eliminate chemical weapons with adequate verification on that score.

We want to have a nuclear testing exchange of expert observers.

We want to have reductions at the MBFR, mutual and balanced force reduction, talks in Vienna.

We want to have confidence building measure steps in Stockholm to preclude a surprise attack in Europe.

I think we have a set of proposals for arms control that really is the most comprehensive and broadest that I know about.

Let me say that we don't get the kind of publicity we should probably because we are not as good in regurgitating the same proposals over and over again as they are, for example with the chemical weapons free zone that Congressman Ray mentioned. But also I think there is just a basic difference, in that the Soviets can come up with any scheme and not have backup material for it at all, and just can proclaim it and go on. We are not that way.

Mr. **Stratton**. Would that apply to the proposal that if we give up part of the SDI they will have deep cuts in their land based missiles?

Mr. **Adelman**. Yes.

Mr. **Stratton**. No specifics. Did they really, did the Senators come back with an idea that maybe that was for real?

Mr. **Adelman**. Well, they can have the idea maybe it is for real, but we just haven't seen it for real where the real battle has been, or should take place, and the real negotiations should take place. We have a negotiating team—a quite extensive and, as you know, an expert team—that is in Geneva to receive Soviet proposals and we just haven't seen them.

Mr. **Ray**. Is there any way we can focus on these serious proposals that you have mentioned there and get them out? We can't see that too much in our own press. I read fairly well. It is hidden back in the background.

Mr. **Adelman**. I know that.

Mr. **Ray**. We need some sort of way to really move this out into the forefront.

Mr. **Adelman**. I agree with you.

Mr. **Stratton**. ABC has it all on tape here today. We will hope to see 1½ hours of it tonight.

Mr. **Adelman**. Are you a betting man, Mr. Stratton?

Mr. **Stratton**. No, no, I never bet.

Mr. **Adelman**. I will take a bet on 1½ hours. I think it is fairer to say though a minute and a half.

Mrs. **Byron**. Thirty seconds?

Mr. **Adelman**. I think it is fair to say that any leader that is asked questions like those that the Time magazine people put to Mr. Gorbachev, is going to come off very, very well. I can't conceive of a news magazine asking those kinds of questions to a President of the United States and letting the statements about how God on high in the Soviet Union would want the Soviet reader to do something, how they have democracy in the Soviet Union, and such. Just to let those go, and move on to the next question, I can't conceive of that happening to a leader in a free country.

Mrs. **Byron**. Mr. Courter, do you have any questions? We have a vote on the floor.

Mr. **Courter**. I will get them out real quickly.

Is it the opinion of your agency that the SS-20s has potential ICBM capabilities, if you either throw a third stage on it, because it is compatible to the SS-16?

Mr. **Adelman**. Yes sir.

Mr. **Courter**. And/or also reducing payload weight by reduction of three warheads to one.

Also a second question, is the problem of a comprehensive test ban treaty from our perspective, the fact that we just simply can't verify very small yield nuclear tests?

Mr. **Adelman**. There are two problems with the CTB. First is the verification difficulty that we have not seen a way to overcome, and second, the problem of the nuclear weapons as ultimate guarantor of our security and our freedom.

On your first question, there have been studies over the years that I would be happy to share with you, that are classified, on the potential upgrade of SS-20 for intercontinental range. Certainly it is safe to say that the SS-20, being the two stages of the SS-16, was one of the reasons that SS-16 was banned entirely—for deployment—by the SALT II treaty. One of our compliance issues, over the years, has been whether the SS-16 is actually deployed or not deployed; we have found, in the past two studies that you have remarked upon, Madam Chairman, that there is some indication that the 16 could be deployed, which causes some concern.

Mr. **Courter**. Thank you.

Mrs. **Byron**. Any other questions?

Mr. **Courter**. No.

Mrs. **Byron**. Thank you very much. I, once again appreciate your candid views this morning in your statement in answering our

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questions. I appreciate having the opportunity to get an update once again for the panel this year.

Mr. **Adelman**. I enjoyed it.

[Whereupon, at 12 noon, the hearing was adjourned.]

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# MILITARY IMPLICATIONS OF ARMS CONTROL

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House of Representatives, Committee on Armed Services, Special Panel on Arms Control and Disarmament of the Procurement and Military Nuclear Systems Subcommittee,

*Washington, DC, Wednesday, September 18, 1985.*

The special panel met, pursuant to call, at 10:15 a.m., in room 2118, Rayburn House Office Building, Hon. Beverly B. Byron (chairman of the special panel) presiding.

## STATEMENT OF HON. BEVERLY B. BYRON, A REPRESENTATIVE FROM MARYLAND, CHAIRMAN, SPECIAL PANEL ON ARMS CONTROL AND DISARMAMENT OF THE PROCUREMENT AND MILITARY NUCLEAR SYSTEMS SUBCOMMITTEE

Mrs. **Byron**. Mr. Perle, I apologize. Unfortunately, they are never going to get finished with fixing the Cabin John Bridge.

In the hearings last week, the panel concentrated on the diplomatic side of arms control. During those hearings, we received excellent testimony from the U.S. diplomats who have been closest to the negotiations with the Soviet Union. Members of the panel will have the opportunity for additional fact finding during our forthcoming visits to negotiations in Geneva and Vienna.

The hearings that begin today will deal with subjects that are more directly related to the jurisdiction of the Committee on Armed Services and the Subcommittee on Procurement and Military Nuclear Systems: For example, the relationships of arms control agreements, including future agreements that might grow out of current negotiations or proposals, to our force structure and defense posture.

I think the important question is whether these agreements make a contribution to our national security or whether they have tended to weaken our overall defense posture.

The panel's hearing today, and on September 20, will focus on arms control from different angles than last week's hearings. Our previous hearings have focused on the diplomatic side. This week we will deal with the practical problems and risks that are involved in observing existing arms control agreements and those that may be involved if certain proposals were to be adopted by the United States unilaterally, or as arms control agreements involving other countries.

I have asked the witnesses to specifically address proposals to ban the testing of nuclear weapons as proposed by House Joint Resolution 3 and H.R. 3100. [See App. A and B, pp. 467 and 471.]

As our arms control negotiators have told the panel, it would be easy to conclude a number of cosmetic agreements that would make no contribution to national security; that would not be equitable; that would not be verifiable.

As our negotiators have said, they are looking for agreements that would be somewhat better. Their task is to reduce the tensions, reduce the threats and destructive power of existing weapons and forces while maintaining a verifiable balance at reduced levels. The Congress, along with overwhelming public opinion, will hold them to high standards of equity and verifiability in any agreements that they may be able to produce.

The witnesses this week are experts on the technical and practical problems involved in maintaining the nuclear deterrent, not only for the United States, but for its allies. They have been asked to testify because they represent the best, up-to-date technical U.S. expertise on nuclear weapons and related verification issues. A more experienced and knowledgeable panel of witnesses could not be found on the subject.

Our witnesses this morning will be the Honorable Richard N. Perle, Assistant Secretary of Defense for International Security Policy; the Honorable Richard L. Wagner, Assistant to the Secretary of Defense for Atomic Energy, accompanied by Dr. Ralph W. Alewine III, Director of the Geophysical Sciences Division, Defense Advanced Research Projects Agency [DARPA]; and the Honorable William W. Hoover, Assistant Secretary of Energy for Defense Programs.

I want to welcome them to the panel and I look forward to hearing their testimony.

You may proceed, Secretary Perle.

Mr. PERLE. Thank you——

Mrs. BYRON. Mrs. Holt is not here. Mr. Badham, do you have an opening statement?

Mr. BADHAM. I have Mrs. Holt's statement that I will present.

Mrs. BYRON. Please proceed.

## STATEMENT OF HON. MARJORIE S. HOLT, A REPRESENTATIVE FROM MARYLAND, RANKING MINORITY MEMBER, SPECIAL PANEL ON ARMS CONTROL AND DISARMAMENT OF THE PROCUREMENT AND MILITARY NUCLEAR SYSTEMS SUBCOMMITTEE PRESENTED BY HON. ROBERT E. BADHAM, A REPRESENTATIVE FROM CALIFORNIA

Mr. BADHAM. Madam Chairman, I want to join you in welcoming the distinguished witnesses this morning. We are, of course, well acquainted with the outstanding work that they have been doing for our defense, and we have valued their advice over the years.

Mrs. Holt says that she particularly wants to express her appreciation, and I also join, to General Hoover who has served his country well for three decades: As a decorated officer of the U.S. Air Force, as the head of DOE's Office of Military Applications, and as Assistant Secretary of Energy for Defense Programs. I understand that this may be General Hoover's last appearance before us as Assistant Secretary of Energy, and we wish him well.

Madam Chairman, I fully agree with your assessment that the panel of witnesses scheduled for today and for Friday are the most knowledgeable individuals on nuclear weapons technical issues that can be found in the United States. In my opinion, it is important and appropriate that we obtain the best information possible on these issues, especially since a large number of our colleagues are, once again, proposing simplistic solutions to complex problems—proposed "cures" that may be worse than the disease.

I am referring, of course, to H.R. 3100, the latest "freeze" proposal or "Freeze III," and House Joint Resolution 3, that would attempt to force a comprehensive nuclear test ban.

The "freeze" that H.R. 3100 would impose appears to me to be more unilateral, less mutual, and less verifiable than any previous proposal. In addition, "Freeze III" is not the usual "sense of the Congress" resolution.

H.R. 3100 would cut off all funds appropriated for DOD and DOE in prior years, or for any other year, for strategic modernization or for modernization of tactical nuclear forces. It would kill all weapons R&D and testing, and in addition, it would prevent the assembly of any B-1's, Tomahawks, and any other nuclear weapon for at least 7 months after enactment of the bill. Meanwhile, the all-nuclear test facilities, the B-1 assembly facilities, Minuteman II and III rework facilities, MX and other missile assembly facilities would be closed down for at least a 7-month period.

I hope that the witnesses today have analyzed this new freeze proposal and are prepared to comment on its probable effect of our force structure and deterrent forces.

It is my hope, Madam Chairman, that we will have an opportunity before this session of Congress adjourns to invite the chief sponsors of House Joint Resolution 3 and H.R. 3100 to testify on the effect that those measures would have on our defense posture and what benefits could be expected if those measures were to become law.

Thank you, Madam Chairman.

Mrs. Byron. Thank you very much.

Mr. Secretary, you may proceed.

## STATEMENT OF HON. RICHARD N. PERLE, ASSISTANT SECRETARY FOR INTERNATIONAL SECURITY POLICY, DEPARTMENT OF DEFENSE

Mr. Perle. Thank you very much, Madam Chairman.

I should like to thank you for inviting me to contribute to the special panel's deliberations on arms control. You have already heard from a number of administration officials on this subject, many of whom are involved directly in negotiations with the Soviet Union in a variety of bilateral and multilateral negotiations. I shall try not to repeat what they have had to say about the American position in those talks.

I should prefer simply to observe that a good deal of thought has gone into our various positions and that we have made a number of proposals with a view to negotiating agreements that would lessen the threat to our security in a manner that is militarily significant, equitable, balanced and verifiable.

In a number of cases, we have rejected the advice of prominent experts who have counseled us to put forward proposals that we believe would not only fail to diminish the threat we face, but would almost certainly increase it. Some of these proposals—the idea of a freeze, for example, or a comprehensive ban on nuclear testing—amount to little more than slogans which, however appealing to their proponents, fit better on T-shirts than into a serious national strategy.

From time to time our skepticism about proposals that are hopelessly vague or that would fail to achieve the purpose of their proponents has led our critics to question the seriousness with which we regard the subject of arms control and the depth of our desire to conclude agreements. I want to assure you that we view arms control with the utmost seriousness. And it is precisely because we desire deeply to conclude agreements that will protect our national security and the safety of our people and our democratic institutions that we have resisted the temptations of T-shirt diplomacy, even though the sponsors of House Joint Resolution 3 and H.R. 3100 have not.

### HOUSE JOINT RESOLUTION 3

House Joint Resolution 3 calls upon the President to request the advice and consent of the Senate to ratification of the Threshold Test Ban Treaty signed in 1974. As members of this panel know, we have not sent the Threshold Test Ban Treaty forward for ratification because we are unable to verify compliance with its terms and because there is substantial evidence that the Soviets are violating it by testing at levels greater than 150 kilotons.

Messrs. Bedell, Leach, Markey, and others too numerous to list dance all around the issues of verification and compliance in urging that we ratify an unverifiable threshold test ban and then propose an equally unverifiable comprehensive test ban to the Soviet Union. I have not the slightest doubt that the Soviets would cheerfully agree to a comprehensive ban on nuclear testing. But such an agreement would be adhered to unilaterally—by the United States—while the Soviet Union continued surreptitiously to test in a manner that we could not reliably detect.

I must say that I find the confidence that Bedell, Leach and Markey continue to attribute to Soviet undertakings in this area more than a little naive. Simply asserting that a comprehensive test ban "must be adequately verifiable," as House Joint Resolution 3 does in paragraph 5, is no substitute for the reality that such a ban would not be verifiable—a reality made all the more salient by the massive Soviet cheating that the President has reported to the Congress on a variety of other arms control agreements, including SALT and the ABM Treaty.

Should House Joint Resolution 3 pass—and I hope it will not—it would merely encourage the Soviet Union to continue to refuse to sit down with the United States to discuss measures that might improve the verifiability of the unratified threshold test ban to the point where we could responsibly recommend that the Senate gives its consent to ratification.

So concerned are the Soviets to avoid discussing the verifiability of the threshold test ban that they have, until now, refused even to send their technicians to our Nevada test site to measure for themselves an American underground nuclear test. I find this disappointing, but hardly surprising. One cannot blame Mr. Gorbachev for being as unresponsive to President Reagan as the sponsors of House Joint Resolution 3.

My colleague, Richard Wagner, whose excellent testimony I have read, will discuss in greater detail the many reasons why we believe that so long as we base our security and that of our allies, on nuclear weapons it would be most unwise to cease testing them.

For reasons of safety, security, reliability and confidence, we are compelled to test. And for all the talk about verifying a mutual ban on testing, the impact of such a ban would not be mutual at all. It would greatly favor the Soviet Union for reasons that Richard will elaborate. And, of course, it would not be verifiable.

But let us suppose for a moment that a comprehensive ban on nuclear weapons testing were mutual in effect—that is, it would constrain us and the Soviets in equal measure—and be wholly verifiable. Would it be safe to assume that the Soviets would not cheat? I am unaware of any effective action to bring an end to current Soviet cheating that has been mounted by the many sponsors of House Joint Resolution 3, a resolution introduced in the House almost 2 years after President Reagan first found, and reported to the Congress, that the Soviets were violating the most important arms control agreements that exist between us.

There was, as I recall it, a sternly worded letter to Mr. Gorbachev signed by a number of House Members some months ago deploring one such violation, the construction, contrary to the ABM Treaty, of a radar at Krasnoyarsk. Some of the signers are sponsors of House Joint Resolution 3. I don't know whether they ever got a reply from Gorbachev, but I do know that the construction of the illegal radar continues.

The point I wish to make is that until the Soviets cease the many violations of current agreements that have been the subject of two Presidential reports, we can hardly look forward with confidence to their compliance in the future. And arms control without Soviet compliance is unilateral disarmament no matter how often its proponents use the words "mutual and verifiable" in their speeches and resolutions.

### H.R. 3100

Madam Chairman, I should like to conclude with a word or two about H.R. 3100, a 17-page caricature wherein Congressman Markey can be seen overreacting to the criticism that his 1984 version of the nuclear freeze was too simple. I would give anything to hear the KGB briefing the Soviet arms control agency on what Markey and his colleagues are up to, but the Soviets don't have an arms control agency—and they certainly don't have anyone who thinks like Congressman Markey—so I suppose I will never know how H.R. 3100 is regarded in the Kremlin.

I can tell you how I regard it. It is perhaps the silliest piece of legislation that I have seen in almost 20 years of observing the

Congress. No one who could vote for it with a straight face should be permitted to use the word "serious" in any sentence in which the words "arms control" are to be found.

The process of developing arms control agreements that are serious—carefully conceived, analyzed, formulated, proposed, negotiated and implemented—is difficult, complex, and uncertain. Arms control agreements cannot be wished into existence just as they cannot be legislated in Washington.

I believe that this administration has worked hard to present serious proposals on intermediate nuclear forces, on strategic nuclear forces, on chemical weapons, on confidence-building measures, on mutual and balanced force reductions, and on nuclear testing. And we have endeavored to obtain Soviet agreement to those proposals.

We will continue to do so despite the many obstacles erected by the Soviets and despite the encouragement they draw from legislative measures like House Joint Resolution 3 and H.R. 3100. In doing so, I want to assure you that we will set for ourselves as an administration and for our country the standard to which I alluded at the opening of these remarks.

The agreements that we seek must be militarily significant, equitable, balanced and verifiable, and I would add one last criterion. They must not be of such a nature that, were the Soviets to violate them, they would jeopardize our fundamental national security interests. Our experience with Soviet violations has been sobering; and a continuation of the pattern of violations that we are now observing can only diminish further the scope for agreements between us.

Madam Chairman, I would like to conclude those opening remarks. I will be pleased to respond to any questions that the panel may have. I have avoided getting into a lot of detail because I know you have received a great deal of testimony.

### Prepared Statement of Hon. Richard N. Perle

Madam Chairman, I should like to thank you for inviting me to contribute to the Special Panel's deliberations on arms control. You have already heard from a number of administration officials on this subject, many of whom are involved directly in negotiations with the Soviet Union in a variety of bi-lateral negotiations. I shall try not to repeat what they have had to say about the American position in those talks. I should prefer simply to observe that a good deal of thought has gone into our various positions and that we have made a number of proposals with a view to negotiating agreements that would lessen the threat to our security in a manner that is militarily significant, equitable, balanced and verifiable.

In a number of cases we have rejected the advice of prominent experts who have counseled us to put forward proposals that we believe would not only fail to diminish the threat we face but would almost certainly increase it. Some of these proposals—the idea of a freeze, for example, or a comprehensive ban on nuclear testing—amount to little more than slogans which, however appealing to their proponents, fit better on T shirts than into a serious national strategy.

From time to time our scepticism about proposals that are hopelessly vague or that would fail to achieve the purpose of their proponents has led our critics to question the seriousness with which we regard the subject of arms control and the depth of our desire to conclude agreements. I want to assure you that we view arms control with the utmost seriousness. And it is precisely because we desire deeply to conclude agreements that will protect our national security and the safety of our people and our democratic institutions that we have resisted the temptations to T shirt diplomacy, even though the sponsors of H.J. Res 3 and H.R. 3100 have not.

H.J. Res 3 calls upon the President to request the advice and consent of the Senate to ratification of the threshold test ban treaty signed in 1974. As members of this Panel know we have not sent the threshold test ban treaty forward for ratification because we are unable to verify compliance with its terms and because there is substantial evidence that the Soviets are violating it by testing at levels greater than 150 kilotons. Messrs Bedell, Leach, Markey and others too numerous to list dance all around the issues of verification and compliance in urging that we ratify an unverifiable threshold test ban and then propose an equally unverifiable comprehensive test ban to the Soviet Union. I have not the slightest doubt that the Soviets would cheerfully agree to a comprehensive ban on nuclear testing. But such an agreement would be adhered to unilaterally—by the United States—while the Soviet Union continued surreptitiously to test in a manner that we could not reliably detect.

I must say that I find the confidence that Bedell, Leach and Markey continue to attribute to Soviet undertakings in this area more than a little naive. Simply asserting that a comprehensive test ban "must be adequately verifiable," as H.J. Res 3 does in paragraph five, is no substitute for the reality that such a ban would not be verifiable—a reality made all the more salient by the massive Soviet cheating that the President has reported to the Congress on a variety of other arms control agreements including SALT and the ABM Treaty.

Should S.J. Res 3 pass (and I hope it will not) it would merely encourage the Soviet Union to continue to refuse to sit down the United States to discuss measures that might improve the verifiability of the unratified threshold test ban to the point where we could responsibly recommend that the Senate ratify it. So concerned are the Soviets to avoid discussing the verifiability of the threshold test ban that they have, until now, refused even to send their technicians to our Nevada test site to measure for themselves an American underground nuclear test. I find this disappointing but hardly surprising. One cannot blame Mr. Gorbachev for being as unresponsive to President Reagan as the sponsors of S.J. Res 3.

My colleague Richard Wagner, whose excellent testimony I have read, will discuss in greater detail the many reasons why we believe that so long as we base our security, and that of our allies, on nuclear weapons it would be most unwise to cease testing them. For reasons of safety, security reliability and confidence we are compelled to test. And for all the talk about verifying a mutual ban on testing the impact of such a ban would not be mutual at all. It would greatly favor the Soviet Union for reasons that Richard will elaborate. And, of course, it would not be verifiable.

But let us suppose for a moment that a comprehensive ban on nuclear weapons testing were mutual in effect—that is, it would constrain us and the Soviets in equal measure—and wholly verifiable. Would it be safe to assume that the Soviets would not cheat? I am unaware of any effective action to bring an end to current Soviet cheating that has been mounted by the many sponsors of H.J. Res 3, a resolution introduced in the House almost two years after President Reagan first found, and reported to the Congress, that the Soviets were violating the most important arms control agreements that exist between us.

There was, as I recall it, a sternly worded letter to Mr. Gorbachev signed by a number of House members some months ago deploying one such violation, the construction, contrary to the ABM Treaty, of a radar at Krasnayarsk. Some of the signers are sponsors of H.J. Res. 3. I don't know whether they ever got a reply from Gorbachev but I do know that the construction of the illegal radar continues.

The point I wish to make is that until the Soviets cease the many violations of current agreements that have been the subject of two Presidential reports we can hardly look forward with confidence to their compliance in the future. And arms control without Soviet compliance is unilateral disarmament no matter how often its proponents use the words "mutual and verifiable" in their speechs and resolutions.

Madam Chairman, I should like to conclude with a word or two about H.R. 3100, a 17 page charicature wherein Congressman Markey can be seen over-reacting to the criticism that his 1984 version of the nuclear freeze was too simple. I'd give anything to hear the KGB briefing the Soviet arms control agency on what Markey and his colleagues are up to. But the Soviets don't have an arms control agency—and they certainly don't have anyone who think like Congressman Markey—so I suppose I'll never know how H.R. 3100 is regarded in the Kremlin.

I can tell you how I regard it. It is perhaps the silliest piece of legislation I have seen in almost 20 years of observing the Congress. No one who could vote for it with a straight face should be permitted to use the word serious in any sentence in which the words arms control are to be found.

The process of developing arms control agreements that are serious—carefully conceived, analyzed, formulated, proposed, negotiated and implemented—is difficult, complex and uncertain. Arms control agreements cannot be wished into existence just as they cannot be legislated in Washington. I believe that this Administration has worked hard to present serious proposals on intermediate nuclear forces, on strategic nuclear forces, on chemical weapons, on confidence building measures, on mutual and balanced force reductions, on nuclear testing. And we have endeavored to obtain Soviet agreement to those proposals. We will continue to do so despite the many erected by the Soviets and despite the encouragement they draw from legislative measures like H.J. Res. 3 and H.R. 3100. In doing so I want to assure you that we will set for ourselves as an administration and for our country the standard to which I alluded at the opening of these remarks. The agreements that we seek must be militarily significant, equitable, balanced and verifiable. And I would add one last criterion. They must not be of such a nature that, were the Soviets to violate them, the would jeopardize our fundamental national security interests. Our experience with Soviet violations has been sobering; and a continuation of the pattern of violations that we are now observing can only diminish further the scope for agreement's between us.

Mrs. **Byron**. What is your timeframe this morning?

Mr. **Perle**. I can stay for about an hour.

Mrs. **Byron**. OK. I think if you don't mind we will have Secretary Wagner's testimony and then ask questions to the two of you because I think some of our questions might overlap since the testimony is in the same area, if that is permissible.

Mr. **Perle**. All right.

Mrs. **Byron**. Secretary Wagner.

## STATEMENT OF HON. RICHARD L. WAGNER, ASSISTANT TO THE SECRETARY OF DEFENSE FOR ATOMIC ENERGY, ACCOMPANIED BY DR. RALPH W. ALEWINE, III, DIRECTOR, GEOPHYSICAL SCIENCES DIVISION, DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

Dr. **Wagner**. Madam Chairman, let me simply say for myself how happy I am to be here to be able to give you my views on these issues and to congratulate you and the panel on holding these hearings to get these facts into the record.

I would like to concentrate this morning on issues related to the test ban itself as opposed to the broader issues of arms control in general.

You have heard several previous speakers address various issues related to nuclear test bans. The Arms Control and Disarmament Agency has stated that it is the policy of this administration that a further extension of the nuclear test ban regime is not in the national security interest of the United States at this time—that a comprehensive test ban is a long-range goal, but that it can only come in the context of extensive progress in those aspects of arms control which actually limit and control nuclear weapon force structure, so that we would not need to rely as much as we do today on those aspects of deterrence to which nuclear warhead design contributes. When that time comes, any further extension of the test ban regime must, of course, be adequately verified.

You will hear the DOE and the directors of the nuclear labs state that nuclear weapons testing is essential to continuing development of those features in the nuclear warheads which contribute to their deterrent value. They will also tell you that nuclear testing is essential to maintain confidence in the reliability of the stockpile which exists today or in the future.

You have heard Mr. Perle describe why the provisions of House Joint Resolution 3 and H.R. 3100 would be counterproductive to our objectives of national security and truly effective arms control.

Mr. **Stratton**. Madam Chairman, I can't follow the witness' statement.

Dr. **Wagner**. I am sorry, Mr. Stratton. I was going to submit that statement for the record and read a shorter section of the statement which I believe contains particularly important point, and, in fact having said that, I do have this longer statement for the record.

Mrs. **Byron**. We will submit that for the record.

Dr. **Wagner**. You will also hear several speakers address the various approaches to verification of test bans using seismic methods or other means, including incountry techniques.

These discussions of seismic verification, I am sure you will agree, tend to be quite arcane, depending on theories about geophysics and complicated statistical analysis, all of which makes them hard to apply in the real world process of judging Soviet compliance with test bans.

My own prepared statement summarizes many of these points, but this morning I would like to add to this body of information the following point, which I believe is central to your considerations here. It is that an important reason why a further extension of the test ban regime at this time would not be in the national interest of the United States is that the United States almost certainly relies considerably more on nuclear warhead design for achievement of our national security objectives than does the Soviet Union. Let me develop this point a little further for you.

### TECHNOLOGIES NECESSARY FOR NATIONAL SECURITY

The United States relies on a great variety of technologies to achieve our national security objectives. These include such things as missile guidance accuracy, submarine quieting, satellite surveillance, communications, and many more—and, of course, the technology of nuclear warhead design.

There is a similar list for the Soviet Union, also including the technology of nuclear warhead design. I believe that among those many contributions of technology to deterrence, the United States relies more on the contributions of warhead technology than does the Soviet Union.

Two examples that I can speak to here relate to, first, the safety, security and control of the weapons, which are fundamental to our ability to have and deploy nuclear weapons at all; and second, the yield, weight, and size of the warheads, which determine directly the military effectiveness of the weapons systems and their ability to threaten the targets necessary to make deterrence effective.

The United States has standards of safety for our nuclear weapons which are almost certainly higher than those required by the Soviet Union. We have, and I have little doubt the Soviets also have, highly effective means to preclude an actual nuclear explosion in any accident involving a nuclear weapon. But for us, there is a great deal more to nuclear warhead safety than this.

For example, we go to great lengths in warhead design to preclude even dispersal of radioactive material in an accident. The hazard from such dispersal is moderate but, by the standards of our society, unacceptable.

Similarly, we stringently limit the already low levels of radiation emitted by the warhead to ensure minimum possible radiation exposure to troops maintaining and transporting the weapons in peacetime.

By contrast, everything we know about safety practices in the Soviet Union, and there is a lot of evidence, says that they would simply not be concerned about such things, and would not develop warhead design features for these reasons.

I believe there is a similar asymmetry with regard to security and control features in the warheads. The United States and, no doubt, the Soviets as well have highly effective means to prevent unauthorized launch of nuclear weapons by those who have legitimate custody of the weapons. But partly because of the open nature of democratic societies, we go to great lengths to build features into our warheads to protect against actions of outsiders—terrorists, psychotics, et cetera.

In contrast, the Soviets almost certainly can rely much more on rigid controls over their populace, and on controls external to the warheads, rather than having to rely on warhead design.

There is also a striking asymmetry in the extent to which the two nations need to maximize the yields for a given warhead weight, or miniaturize the warheads at a given yield. For decades, the Soviet Union has had an extensive program to harden, disperse and hide its national security assets, including not only its weapons and military forces, but its military-related industries and its leadership.

We have only recently come to understand the remarkable extent of this program. In contrast, most locations in the United States which the Soviets might target are soft—with the exception of Minuteman silos and a few other sites—and their locations are well known. Since the Soviets have now achieved essentially the same delivery accuracies, and since their missile throw weight is much greater, the Soviet Union almost certainly does not need to optimize the yield-to-weight ratio of its warheads to the extent that the United States must—even for the smaller warheads that are now entering their inventory.

In a classified discussion, I could add other similar examples of how differences in the strategic objectives, the delivery systems, and the political and societal perspectives of the United States and the Soviet Union require us to rely more on advanced technology warhead designs than the Soviet Union.

### U.S. STOCKPILE OLDER THAN THE SOVIETS'

One final point is that, on the average, the warheads in the United States stockpile are older than those in the Soviet stockpile. This is basically because the Soviets began large quantity production later than the United States, and because in the last decade they have had a much more aggressive system modernization program than the United States.

This fact—which was perhaps to our advantage in the 1970's—now means that their stockpile contains technology more recently developed by their design labs than does ours. It would also be an advantage to them with regard to unreliability which might creep into static stockpiles due to aging during a comprehensive test ban.

Therefore, to whatever extent Soviet proposals for further limitation of nuclear testing may be serious and genuine, rather than only for political or propaganda purposes, I believe it is because of this asymmetry in the needs of the two nations for this technology that further limitations on testing would be to Soviet advantage—even if we could adequately verify testing limitations, which we cannot.

Therefore, as long as we must continue to rely on technology and its contributions to safety, effectiveness, collateral damage reductions, and survivability, nuclear testing and a strong deterrent posture will remain inseparable. Consequently, even if verification were not a concern—and it is—under present circumstances, a total test ban would not serve our national security interests.

Madam Chairman, that concludes what I wanted to say and I, too, will be happy to accept questions.

### PREPARED STATEMENT OF HON. RICHARD L. WAGNER, JR.

Madan Chairman and members of the panel, it is my pleasure to appear before you to discuss the Department of Defense's perceptions of this country's nuclear weapons test program in the context of various treaties which could impact that program. I will particularly focus on the impact of a total ban on testing. Much of what I have to say today will be flavored by by prior technical experience. Before being appointed to my present position in the Department of Defense, I was the associate director for testing at Lawrence Livermore National Laboratory, and before that I was responsible for a major part of that laboratory's design program. But my thoughts go beyond that experience, specifically, there has been a growing confirmation on my part that if we, as a society, elect to remain free and at peace, we have no other alternative available to us at this but to maintain the effectiveness of our strategic and tactical nuclear deterrent. True, we are now undertaking research to examine the possiblity of moving away from a deterrence posture based on the threat of nuclear retaliation toward a posture based on strategic defense. That course is being carefully investigated, and we hope it will eventually lead us to a world described by President Reagan as one secure from the menace of nuclear weapons—but we are not there yet. Unitl such time as we are, we must be exceedingly cautious that our actions, even our best intended actions, do not adversely impact our nuclear deterrent vis-a-vis the nuclear forces of the Soviet Union.

In looking at this issue, let me first review how nuclear testing fits into our national security posture and why, because of the need for caution, we must carefully scrutinize any ban on nuclear testing.

As it has for the last four decades, the security of the United States and its allies today depends upon our maintaining a credible nuclear deterrent. Nuclear testing assures the credibility of this deterrent, permitting us to modernize in response to new challenges, and to maintain the reliability of those weapons already stockpiled. I should add that we have had to sustain this deterrence in the face of the unprecedent and unilateral Soviet buildup of nuclear weapons particularly over the last fifteen years.

Testing is indispensable to the nuclear weapons development process. It is the means by which we insure that the warheads and weapon systems are safe and secure, that they are reliable and effective, that they could, if required, perform their military missions with as little collateral damage as possible and, perhaps most important for the stability of deterrence, that the weapons systems themselves are survivable. Let me treat each of these contributions briefly in turn.

In the democracies, there is, and must always be, a special relationship of trust between our people and those who are responsible for developing and maintaining these weapons. To honor this trust, we must insure that nuclear weapons are safe, secure, an controlled. With us, this is not a matter of cost trade-offs or of stopping at some point deemed "safe enough." Rather, nuclear weapon safety must be absolute. As the requirements of deterrence change, and as the characteristics of the systems of which nuclear warheads are a part change, this requirement for safety remains immutable, but the highest standards of safety and security cannot be assured without nuclear testing. While reasons of classification preclude my being more specific in an open forum, a substantial portion of our testing program since 1962 had gone toward enhancing the safety and security of nuclear weapons. The fact is that many of the most effective safety features which we have incorporated into our nuclear weapons today probably would not be there had we not been able to test.

As to weapon effectiveness, one aspect—certainty in the reliability of the warheads—warrants some elaboration. Testing is vital for establishing and maintaining confidence in the operability and reliability of nuclear weapons, just as realistic testing is essential for aircraft, radars, or any other complicated equipment. Few thinking persons would suggest that we build a strategic bomber which we would not fly until the Klaxon sounded. Yet, a comprehensive test ban treaty (CTBT) would preclude the testing of the nuclear weapon that bomber and its crew might be called on to deliver. I hope the proponents of a CTBT realize the import of this inconsistency. Of course, some would content that we could determine the operational parameters of nuclear weapons through computer simulations and component testing. The same could be said for bombers, but hard experience—recent hard experience—has shown us that calculations do not suffice; and even though we have made enormous strides in simulation testing, the fact remains that there is no way to experimentally simulate the total performance of a nuclear weapon. This observation is especially the case for us where dimensional and weight constraints and our concerns for safety and security have forced us to employ more complex and sophisticated designs. Thus, nuclear testing contributes directly to our confidence in the reliability and operability of our nuclear deterrent. Confidence, in turn, goes to the very heart of stability.

Similarly, a substantial fraction of our development effort has sought to reduce the potential for collateral damage—that is, damage not needed to secure deterrence. Reducing potential collateral damage, if deterrence were to fail, is not only a moral imperative; it also has a direct relationship to deterrence. A deterrent posture would be less credible in a crisis situation if an adversary though we might not retaliate because of the consequences of excessive destruction. Nuclear testing is vital to this line of development as well. Indeed, nuclear testing was an important tool which permitted us to reduce the total megatonnage of our stockpile by over three-fourths since 1960.

With regard to survivability, it is a central tenet of our understanding of deterrence that nuclear weapons systems must not present easy targets for enemy attack, otherwise they would create incentives, particularly in a crisis situation when deterrence would be most stressed, for the enemy to capitalize on such vulnerabilities. Nuclear testing contributes to survivability—and crisis stability—in two ways. The first is by developing warheads with characteristics which allow the systems of which they are a part to be more survivable. For example, if the warhead can be made smaller the entire delivery system can be made smaller and, therefore, rendered more difficult to locate, more easily hardened, or given extended range. The other way in which nuclear testing contributes to survivability is by exploring the complex effects of nuclear weapons so as to insure that our systems and their basing modes do not have unanticipated or hidden flaws. Although these system-hardening and effects tests are not much discussed and constitute a minor portion of our total test program, they are absolutely essential for survivability and, thus, are vital for deterrence.

Therefore, it is by its contributions to safety, effectiveness, collateral damage reductions, and survivability that nuclear testing is essential to our national security interest. As long as we are obliged to rely on retaliatory nuclear capabilities to secure deterrence, nuclear testing and a strong deterrent posture will remain inseparable. Consequently, even if verification were not a concern—and it is—under present circumstances, a total test ban would not serve our national security interests.

Not only would a CTBT be contrary to national security interests, a total ban on the testing of nuclear weapons at this time would not serve the interest of arms control. As I have indicated, a comprehensive test ban would degrade the security of the United States and, thus, international stability. Without nuclear testing, the credibility of our nuclear deterrent would erode, as would our confidence in the reliability of the nuclear stockpile and in our nuclear technology base. This latter aspect would include a diminution of the expertise of nuclear weapon designers and engineers. While we cannot predict or measure the exact rate of this erosion, we are certain that it would occur.

It is sometimes wrongly argued that, absent testing to maintain confidence in reliability, nuclear weapons systems would lose their utility and would, in some undefined way, wither away. This belief may make a nice theory, but in the real world what would happen is that both sides would compensate for worst-case estimates of unreliability by using higher yields and deploying more warheads. Indeed, such pressures could be damaging to arms control efforts to reduce force levels—efforts that are much more important than any putative benefits of a test ban. Moreover, any decreased warhead reliability would carry us in the wrong direction as far as stability is concerned. Relying on uncertainty to accomplish nuclear disarmament, and especially on symmetry or uncertainty, is literally rolling dice for the future of the world.

A comprehensive test ban treaty, therefore, at best would be only an indirect, ineffective approach to achieve reductions and eventual elimination of United States and Soviet nuclear weapons. At its worst, such a treaty would be destabilizing and would increase the very forces which have historically caused arms building—insecurity and doubts as to the effectiveness of extant weapon systems.

Potential erosion of nuclear capability would not necessarily occur symmetrically, and we would not even be able to gauge any resulting disparity. In contrast, given our open society, the Soviets would probably come to know about problems we might have. Furthermore, since the Soviets are believed to be more conservative in their designs than the United States, the Soviet stockpile could be more durable in a no-test environment. Certainly their missile throw-weight advantage would enable them to fall back on heavier, even more conservative designs, which generally should be more reliable and durable during a complete ban on testing.

Of course, asymmetries disadvantageous to the United States could also develop if the Soviet Union covertly violated the test ban. While we cannot predict future Soviet behavior, the Soviet record of noncompliance with arms control agreements increases our concern in this regard. The Soviet Union certainly would be tempted to do whatever it deemed necessary to maintain the reliability of its nuclear forces, arms control obligations notwithstanding.

At a time when the temptation to violate a CTBT could be the strongest, the United States would not be able to verify compliance effectively because of the limitations in the capabilities of our national technical means. This would be true particularly if the Soviets (or others) actively took steps to evade surveillance. The Soviet Union could conduct clandestine tests to maintain the credibility of their nuclear forces, design some new nuclear weapons, and maintain the skills of their weapons designers. In our own experience, we have seen that even one low-yield test could mean the difference between having a reliable weapon in the stockpile and not having that weapon.

Techniques to avoid or reduce the risks of being detected are many. Tests could be conducted in cavities, thereby decoupling the energy of the explosion from the surrounding medium. This technique could enable a violator to test at militarily significant yields, approximately 10 kilotons or so, without producing seismic signals that we could detect or distinguish from those of earthquakes. Tests could be undertaken in outer space, in remote ocean areas, or in the atmosphere above remote parts of the world. A CTBT would increase the incentives for going to these environments where U.S. capability to verify compliance is more marginal. Even if we were able to detect and identify nuclear tests in these environments, we may not be able to attribute the test to a particular Nation with the requisite proof. Even if we collected samples of debris from the event, we would find that nation-of-origin stamps are not embossed on radioactive debris. Finally, a violator could use erthquakes to mask covert nuclear tests. This evasion method could enable the Soviets to test several times a year, and once or twice a year at appreciable yields.

Of course, these covert methods are hypotheses although the Soviets have already at least experimented with partially decoupled tests. But one fact is certain, the nature of the Soviet system would permit the Soviet Union to keep its most skilled technical people in the weapons program and to keep their skills finely tuned—possibly through clandestine testing. In addition, their centralized economy would facilitate efforts to maintain a vigorous nuclear weapons program. By contrast, as we learned during the 1958–61 moratorium on nuclear testing, U.S. weapon designers, engineers, and testing personnel will leave the weapons program for more challenging fields. The loss of these people, who would comprise the corporate body of U.S. test experience, will prevent the United States from promptly resuming nuclear testing in the face of a Soviet breakout. Perhaps more serious, correcting stockpile problems which will surely occur will be precluded, leading to an erosion in our confidence in our nuclear deterrent stockpile.

Proponents of a test ban often argue that, with adequate verification, the Soviets would also be forced to give up technical improvements. But an important reason why a further extension of the test ban regime at this time would not be in the U.S. national interest is that we almost certainly rely considerably more on nuclear warhead design for achievement of our national security objectives than does the Soviet Union. Let me amplify on this point, because I believe it is important.

The United States relies on a great variety of technologies to achieve our national security objectives. These include such things as missile guidance accuracy, submarine quieting, satellite surveillance, communications, and many more. Of course, the technology of nuclear warhead design would be included also. A similar list exists for the Soviet Union, also including the technology of nuclear warhead design. But it is obvious that for various reasons the United States and the Soviet Union put different emphasis on these technologies, and I believe the United States relies more on the contributions of warhead technology than does the Soviet Union.

For example, the United States has standards of safety for our nuclear weapons which are almost certainly higher than those required by the Soviet Union. We have, and no doubt the Soviets also have, highly effective means to preclude a nuclear explosion in any accident involving a nuclear weapon. But for us, there is a great deal more to nuclear warhead safety than preventing accidental explosions. We go to great lengths in warhead design to preclude even dispersal of radioactive material in an accident. The hazard from such dispersal would be moderate but, by the standards of our society, totally unacceptable. Similarly, we stringently limit the already low levels of radiation emitted by the warhead to ensure minimum possible radiation exposure to troops maintaining and transporting the weapons in peacetime. By contrast, everything we know about safety practices in the Soviet Union, and there is a lot of evidence, says that they would simply not be concerned about such things, and would not feel compelled to develop warhead designs incorporating those features.

Similar asymmetry exists with regard to the security and control of nuclear warheads. The United States and, no doubt, the Soviets as well, have highly effective means to prevent unauthorized launch of nuclear weapons by those who have legitimate custody of the weapons. But partly because of the open nature of democratic societies, we go to even greater lengths to build features into our warheads to protect against actions of outsiders—including terrorists. In contrast, the Soviets almost certainly can rely much more on their rigid controls over their populace, and on controls external to the warheads, rather than having to rely on features of the warhead design itself.

A striking asymmetry is also evident in the extent to which the two nations need to maximize the yields for a given warhead weight, or to miniaturize the warheads at a given yield. For decades now the Societ Union has had an extensive program to harden and disperse its national security assets, including not only its weapons and military forces, but its military-related industries and its leadership as well. We have only recently come to understand the remarkable extent of this program. In contrast, most locations in the United States which the Soviets might target are soft—with the exception of our missile silos and a few other sites—and the locations of these facilities are well known to the Soviets. Since they have not achieved nearly the same delivery accuracies as ours, and since their missile throwweight is much greater, the Soviet Union almost certainly does not need to optimize the yield-to-weight ratio of its warheads to the same extent that the United States does—even for the smaller warheads that are now entering their inventory.

In a classified discussion I could add many other examples of how differences in the strategic objectives, delivery systems, and political perspectives of our two societies have led us to rely more heavily on advanced warhead designs. However, one final point relating to asymmetries is that, on the average, our warheads must now be much older than those in the Soviet stockpile. This observation is basically due to how our two stockpiles evolved. The Soviets began large quantity production later than the United States and, in the last decade, they have had a much more aggressive system modernization program than we have had. Together these facts mean that their stockpile surely contains more recent technology and hardware than does ours. In turn, a more current arsenal would be an advantage to them with regard to unreliability which might creep into static untested stockpiles due to aging.

All of this means, then, that even if effectively verified, a comprehensive test ban would not be in the national security interests of the United States. To whatever extent Soviet proposals for further limitation of nuclear testing may be serious and genuine, rather than only political or propanganda purposes, it is because of these asymmetries in the needs of the two nations that further limitations on testing would be advantageous to the Soviet Union.

Because of these potential asymmetries and uncertainties, a comprehensive test ban would increase the very instabilities in the strategic balance that we are trying to eliminate, partly through arms control. This eventually is the reason we believe that nogotiations on direct arms reductions are the most important item on the arms control agenda. Only carefully planned, programmed, and verifiable arms reductions offer the possibility of increased stability and reduced risks of nuclear war. Indirect means are potentially disastrous.

President Reagan has consistently advocated, and is now pursuing in the negotiations in Geneva, deep reductions in the levels of nuclear weapons in the world. It is this administration's view that deterrence can and should be maintained with much smaller numbers of weapons on both sides, provided those reductions are equitable, verifiable, and contribute to stability. Secretary Gorbachev has also mentioned the possibility that the nuclear arsenals of the Soviet Union and the United States could be reduced. To date, these proposals, made to the press and various U.S. delegations, have not been forthcoming at Geneva.

But we believe that the President's persistence in this area could start a process leading eventually to less reliance on those factors which nuclear testing contributes to deterrence. It must be said, however, that when and if that time comes and the test-ban regime can be safely extended, requirements for certainty of compliance may be even more stringent, because at lower force levels, evasive testing could provide greater leverage.

As the ultimate guarantor of Western security, the United States must be concerned with both the security dimension of test bans and the verification dimension. We are working on many fronts, in bilateral and multilateral fora, to create security conditions under which an expansion of the test-ban regime would enhance rather than diminish stability. We trust that everyone genuinely interested in stable security at lower levels of all armaments will support the President's efforts.

Now I would like to speak about a CTBT in the context of our efforts to control the proliferation of nuclear arms since it is frequently asserted—I believe wrongly so—that a total test ban is essential to our nonproliferation objectives. However, when this assertion has been subjected to the same critical analysis as other arguments supportive of a test ban, it too goes wanting.

Frankly, it is difficult to see how a nuclear test ban could guarantee that the non-nuclear weapon states would foreswear the acquisition of nuclear weapons. A given country's quest to become a nuclear weapon state is governed by two principal factors. First, the country must have a desire to develop a nuclear explosive capability. Second, once having decided to develop a nuclear option, the country must have access to technologies and materials necessary for the fabrication of a nuclear device. The first factor is likely to represent a complex mixture of external threats, irrational phobias, national pride, and perhaps even outright scientific curiosity. In any case, in a frenzied world, splintered by contrived and ancient animosities, impetus for the first factor seldom goes wanting. But, nuclear testing by the United States or the Soviet Union, for that matter, adds little or nothing to either factor.

Ironically, a nuclear test ban in some ways could actually encourage proliferation. For example, if a nation now under the protection of U.S. nuclear guarantees lost confidence in U.S. nuclear capability, it might well decide that its security interests required the acquisition of an indigenous nuclear force.

Moreover, we need to remember that a potential proliferator, who chooses to be bound by a test ban, could still produce unsophisticated nuclear weapons without testing. Such an untested weapon could have a significant military impact in regional conflicts even though there would be some uncertainty in the yield and performance of such a weapon. It is worth noting that even in 1945 when nuclear technology was still in its infancy, the United States did not need a preliminary test of the first nuclear weapon used in war.

I will now devote some discussion to the still unratified threshold test ban and peaceful nuclear explosion treaties. In 1976, the United States and the Soviet Union each stated its intention to observe the 150-kiloton threshold set by the threshold test ban treaty (TTBT) and the peaceful nuclear explosions treaty (PNET), and on several occasions since then, reaffirmed that commitment. Neither side has expressed an intention not to ratify the twin accords. Therefore, each side has an obligation under international law to observe the 150-kiloton threshold. The United States has done so; it is likely that the Soviet Union has not.

Several Soviet tests since 1976 had yields estimated by the United States to be above 150 kilotons. However, large uncertainties in our estimates have prevented us from determining conclusively whether the Soviet Union is, in fact, violating the

150 kiloton limit. As stated by the President in his January 1984 and February 1985 reports to Congress on Soviet noncompliance with arms control agreements, while available evidence remains ambiguous and we have been unable to reach a definite conclusion, available evidence indicates that a number of Soviet nuclear tests likely exceeded the TTBT 150 kiloton threshold.

Unfortunately, the United States cannot, at present, effectively verify the TTBT and the PNET because of these large uncertainties in our capability to estimate Soviet nuclear test yields. Although the TTBT protocol calls for data exchanges upon ratification, intended to reduce these uncertainties, the exchanges are not considered to be an effective aid to verification, because the data are too limited and no provision is included for their independent validation.

The provisions of the PNET protocol do provide for direct on-site yield measurements, and these provisions are often called precedent-setting. In reality they are essentially meaningless. Measurements of Soviet peaceful nuclear explosions (PNES) by U.S. personnel would require Soviet approval for any explosion with a planned aggregate yield exceeding 100 kilotons but not exceeding 150 kilotons. Direct measurements become mandatory only for a group of simultaneous explosions with a planned aggregate yield exceeding 150 kilotons up to the limit of 1500 kilotons. Since Soviet agreement to mandatory on-site inspections (OSIS) in this instance is so contrary to their traditional opposition to mandatory OSIS, it is highly unlikely that the Soviet Union ever forsaw a need for PNES with yields over 150 kilotons so the provisions for OSIS will likely never be exercised. In fact, according to current yield estimates, it is unlikely that any Soviet PNES since 1976 had yields high enough to have required mandatory yield measurements by U.S. personnel even if the treaty had been ratified.

As I indicated, our experience in attempting to verify Soviet compliance with the 150-kiloton threshold of the TTBT using seismic methods has offered a pointed illustration of the limitations inherent in the seismic technique. These difficulties have convinced us that seismic methods, while important, must be augmented by nonseismic methods to verify compliance with test bans in general.

One factor which limits the usefulness of seismic methods is that seismic data on any one test have such large associated uncertainties that compliance judgments must be based on statistical analyses of seismic data and other information accumulated from tests over months, even years. Thus, today, seismic data lacks the specificity and immediacy which are so important in the real-world process of forming, and then acting on, judgments about compliance. For this reason, better means for verifying compliance with the TTBT must be found.

We have invited the Soviets on several occasions to work with us to achieve such improvements, but to date, they have not accepted any of our invitations. In this regard, the President made a proposal in the United Nations on September 24, 1984, for the two sides to find a way to exchange experts at one another's test sites to measure directly the yields of nuclear weapons tests. In addition, on July 29, 1985, we invited the Soviets to come to our test site, bring any equipment they deemed necessary to verify nuclear test yields, and make the measurements necessary to determine the yield of one of our tests. However, they have reacted negatively to these proposals. This response is unfortunate since direct yield measurements would have significantly lower uncertainties for both parties.

Looking further into the future, this need for statistical interpretation of seismic data, which undercuts its utility in TTBT verification, may also be a weakness that is a more general concern. While it is true that the particular problems which will be associated with possible future test-ban regimes cannot be fully anticipated, we do know some of them, and it is clear that greatly improved verification methods will be essential. We have not yet arrived at the requisite point of capability and understanding. Therefore, it is important to continue to improve our research base from which to derive improved verification techniques, both seismic and direct, for the current TTBT and a possible test-ban regime in the future.

In conclusion, while the world we face is complex and rapidly changing, the ultimate goal of American defense remains constant: To preserve the peace and maintain our freedoms. To achieve those goals, our nuclear arsenal must be of adequate strength and dependability to dissuade the Soviet Union from attacking our Nation and its allies. The cost of aggression must always exceed the benefits the aggressor seeks to accomplish. Because our arsenal and resolve have been adequate for 40 years, the tremendous military potential of the Soviet Union has been held in virtual check—no nuclear weapons have been fired in anger, and we are still a free people. By any measure, deterrence has been successful. Thus, we must carefully evaluate any action which could undercut this demonstrated success. For the reasons I have stated, we feel that a ban on the testing of nuclear weapons is one such action which could lead to greater instabilities and would, therefore, not serve the interests of deterrence or of world peace. The peace sought so genuinely and earnestly by the proponents of a CTBT would be more in jeopardy, not less.

That concludes my formal testimony, and I would be happy to answer questions.

Mrs. BYRON. Thank you very much. Let me pursue a couple of questions, some that I asked the other day to some of our ambassadors.

Mr. Perle, let me take a look at what we have seen transpiring within Russia in the last 6 to 8 months with the many changes. We have a new change with Gorbachev, we have a new change with a new foreign minister. We have not so far seen changes in the ambassadorial level on the arms control discussions.

Whether there will be changes when some of the groups return to Geneva and Vienna for the next round is one of the things you never know until they open the door and descend at the beginning of the talks, but do you feel that there is going to be any change of input or, younger outlook within the dialog?

### WILL SOVIET ATTITUDES CHANGE IN GENEVA?

Mr. PERLE. Well, it is, obviously, difficult to be certain about judgments of this nature, but we have seen no change thus far in the positions advanced by Soviet negotiators. We have begun to see a bit of a change in the propaganda that surrounds those proposals, but with respect to the proposals themselves, there has been quite striking continuity, reaching back into the two previous Soviet administrations, and I don't expect frankly to see a dramatic change.

Mrs. BYRON. Do you feel that is because Gorbachev is probably more concerned currently with internal affairs, getting that straightened out as opposed to the thrust toward the arms control negotiations or does it still fit a very high priority and profile?

Mr. PERLE. I don't believe that arms control was a particularly high priority for Chernenko or Andropov or, for that matter, Brezhnev. I think all three looked for opportunities to encumber the American Strategic Modernization Program and saw negotiations as one instrument to accomplish that purpose. I think all three saw arms control negotiations in Geneva as one possible instrument for unraveling the decision taken by NATO in December 1979 to offset the Soviet medium-range missile deployments in Europe. But judging by the proposals put forward under all three Soviet administrations, I think it would be difficult to conclude that they were serious about reaching arms control agreements, although they are quite serious about propagandizing with respect to arms control.

Mrs. BYRON. Do you really believe that we can reach a verifiable agreement?

Mr. PERLE. I think we can conceive of such agreements, analyze them, formulate them carefully and put them on the table, and I believe we have done that with respect to a number of negotiations. I mentioned some of them in my statement, but getting the Soviets to agree to those proposals has thus far proven impossible. They would prefer agreements between us that permit their forces to increase, that permit them to continue with their military buildup, and that are marginal with respect to verification. So long as we insist on the standards that I identified,—military significance, balance, equity, and verifiability—and put proposals on the table that would achieve those purposes, then I think whether there is or is not a result will depend entirely on whether there is a change in Soviet thinking and they begin to negotiate on that basis.

Mrs. **Byron**. Given the fact that we have a new series of talks on the SDI level, the administration in the past has said that our nuclear deterrence probably has kept the peace over the last 40 years. If this is the case, many people are asking why do we need to proceed with our thrust toward SDI. Could you give us——

Mr. **Perle**. I think one of the reasons is that over the last 15 years or so we have seen a steady, unrelenting Soviet buildup of offensive forces with no end in sight. Since the first arms control agreements were signed between us in this area in 1972, the Soviets have made massive additions to their offensive forces.

Since the talks got underway in 1969, they have added something like 8,000 strategic weapons to their arsenal. Now, in my view a continuing competition in offensive arms is destabilizing, and we would be well advised to devise alternatives. Moreover, I think the Soviets have very considerable advantages with respect to the deployment of offensive nuclear arms and missiles in particular. For example, they have many times the land area available for that purpose, than we have in the United States. In addition, there is no significant problem bearing on the interface between nuclear weapons and the Soviet public. They don't have to face H.R 3100 or similar pressures from within the Soviet Union. So for a variety of reasons, I think they are well poised and have demonstrated an interest in availing themselves of the opportunity to continue to deploy improved offensive forces.

Now, the strength of the United States, it seems to me, lies not in attempting to match them in circumstances that are disadvantageous to us, but in looking for a combination of offensive and defensive forces that take full advantage of our technological potential. I can't for the life of me see why we should compete with the Soviets in an area where they are strong rather than competing with them in an area where we are strong. So I think a combination of offense and defense would bring far greater stability to the strategic balance between us and enable us to exploit our strengths and not compete in areas where we are weak.

Mrs. **Byron**. Mr. Ray.

Mr. **Ray**. Thank you, Madam Chairman.

Welcome to the witnesses.

Have there been any real negotiations, in either one of your opinions, on INF or strategic weapons limitations during the first two rounds of talks?

Mr. **Perle**. Not in my judgment. Efforts by our negotiators to draw the Soviets out, to accommodate their concerns, to demonstrate the flexibility that exists on our side, has gone unrequited. The Soviets have largely, for propaganda purposes, staked out positions that they know are totally unacceptable to the United States and to our allies, and they have not deviated from those proposals except to occasionally repackage them.

Mr. **Ray**. Verification is the key to everything we want to accomplish. Have the negotiations proceeded to the point at this time where we can get into verification or have we already gotten into that particular factor?

### VERIFICATION NEGOTIATIONS

Mr. **PERLE**. We have let the Soviets know that we do not anticipate that the proposals we have put forward would be verifiable solely by national technical means of verification, and that is particularly true with respect to such systems as mobile missiles, whether of intermediate or strategic range. However, we have not yet begun the detailed discussion of the verification measures that will be necessary to give us reasonable confidence that we can detect what the Soviets were doing.

But I would like to point out that knowing what the Soviets are doing and detecting violations is only part of the problem. The other part is obtaining Soviet compliance. We are perfectly able to observe the Soviets doing a number of things that are in violation of existing agreements. However, these agreements are not self-enforcing; there is no mechanism by which the Soviets can be compelled to comply with them. For that reason, however we may be able to verify the terms and conditions of agreements we seek to negotiate, in my judgment, we should avoid agreements that are so structured that if the Soviets were to violate them, we would suffer a serious setback to our national security.

Mr. **RAY**. The Soviets are claiming that equity already exists and they, of course, would enjoy a freeze at this point, but how do they justify, or do they even comment on the fact that apparently they are already ready to deploy new mobile strategic and INF weapons. Have our negotiators gotten to the point of discussing this inequity and pointing it out and are they getting any reaction.

Mr. **PERLE**. The Soviets claim that a balance exists, particularly with respect to intermediate nuclear forces in Europe. What is almost comic about the claim is they have been making it for the last 5 years during which time they have deployed up to now 441 SS-20 medium-range ballistic missiles, each with three warheads and each with additional reload missiles.

They have added some thousands of warheads in a period in which the United States, until recently, had added none whatever. Yet, at every stage along the way, they claim that a balance exists. If it existed in 1979 when Brezhnev claimed that a balance existed, it surely did not exist 5 years later after the addition of 1,600 warheads on the Soviet side.

Mr. **RAY**. Gorbachev made a statement 2 or 3 weeks ago, that he would encourage and support a chemical weapons-free zone in Europe. That statement made the front pages of most papers and was prominent in the news. Our offer sometime before that to ban all chemical weapons, completely eliminate all weapons, barely made the news. How can we better focus the media attention on the offers we make, the interests that we have and project?

Do you know of any way that we can get better attention? Do we have a strategy that we are working on to get our views into the forefront?

Mr. **PERLE**. I wish I knew how we could do a better job with publicizing the proposals we have made because I think they will stand up to close scrutiny. I wish we could command the kind of space and attention under similar circumstances in the pages of Time magazine, for example, that Mr. Gorbachev got. It was a really remarkable interview. Not a word critical of the Soviet Union was spoken; not a serious question was raised, in several hours of interview.

We answer the hard questions when they are asked, and we hope that our answers are reported because we think we have credible answers. We think that the proposal, to reduce significantly the strategic forces on both sides, to eliminate entirely intermediate missiles, and to ban completely chemical weapons with a system of challenge inspections, as well as the proposals to adopt additional verification measures affecting nuclear testing, and so forth, are all credible proposals and will stand close scrutiny.

The Soviets have one great advantage when it comes to propaganda and that is there need not be any relationship between what they say and what they do. As an open and democratic society with governmental authority divided between the executive and the legislature and the press, I might add we are not capable of mounting propaganda of that kind. Our actions have to conform to our policies.

Mr. **Ray**. Thank you.

Thank you, Madam Chairman.

Mrs. **Byron**. Mr. Stratton.

Mr. **Stratton**. Thank you, Madam Chairman.

Mr. Perle, the President last night in his press conference apparently surprised a large number of Americans, including a distinguished group of U.S. Senators who had recently visited the Soviet Union, when he announced that he didn't like the idea of trading off anything in the SDI in return for a reduction in offensive weapons on the part of the Soviet Union. I assume that the President took that position decision in line with your recommendations.

Is it fair to say that the real problem in that proposal is the same one that you have mentioned, namely verification? If that tradeoff is made and Mr. Gorbachev announces that they have eliminated 3,000 weapons, we have no way of knowing whether they have really eliminated them. Is that basically the rationale behind the President's proposal?

### VERIFICATION PROBLEMS

Mr. **Perle**. Well, I believe that there are serious verification problems with many of the proposals, which have only been sketched out by the Soviets. They claim they would be prepared to reduce their offensive forces if we would be prepared to limit our SDI program. However, some of the verification problems, in my judgment, are insurmountable. Again, obtaining compliance even with provisions that could be verified is not easy. But it seems to me the principal defect of this idea or a tradeoff is that there already exists a treaty, the ABM Treaty, with which we are abiding, that prohibits the deployment of strategic defenses beyond very limited defenses at a single location.

What the Soviets are seeking to do is bring a halt to the American program of research and development to see whether new technologies will put us in a position to develop a cost-effective strategic defense. We simply don't know how to verify limitations on research and development of the kind that we believe the Soviets have in mind.

Moreover, the Soviets have a vigorous program of research and development on strategic defenses, a program larger than our own and one that goes back further. I frankly don't believe that, if the Soviets entered into an agreement restricting research and development, we could count on them to abide by those undertakings. This strikes me, Mr. Stratton, as one of those areas where the Soviet capacity to cheat, viewed in light of their history of past cheating, strongly suggests that the risk would be very great. It is one of those areas where a little bit of cheating would go a very long way, where a clandestine Soviet development program could put them in a position to deploy a strategic defense and leave us in a very difficult situation.

So I would strongly counsel against accepting the risks involved in limitations on research and development. The President did say last night that he would be prepared to discuss at the appropriate time limitations on the deployment of such systems which are verifiable.

Mr. STRATTON. Considering the prestigous number of Senators that were involved in that meeting, I am surprised that they didn't figure that out for themselves. They seemed to come back with a great deal of enthusiasm: This is the real thing; we've got to do it this way. I think there have been several editorials in the Washington Post and the New York Times suggesting that Mr. Gorbachev has made a great proposal, and I am surprised that the members of the other body, many of them who are members of the Senate Armed Services Committee, seem to be taken in by that suggestion.

Mr. PERLE. Well, I was surprised by the enthusiasm because when one looked carefully at what the Soviet leaders have been saying, it was not at all clear that the reductions would be significant; that is, reductions of the sort that would obviate the requirement for a defense because they would so diminish the threat we would face that we could comfortably maintain a balance without defenses. It was not clear what the Soviets had in mind in terms of curtailments on strategic defensive research. Nor was there reason to believe that when we actually got into negotiations, these vague Soviet suggestions would translate into a fair, balanced, treaty.

Nothing about our negotiating experience suggests that we could look forward to that.

Mr. STRATTON. Thank you.

Mrs. BYRON. Mrs. Holt.

Mrs. HOLT. Thank you, Madam Chairman.

I have no questions. I apologize for coming late. I have read your statements and thank you very much for your very candid and lucid statements. I have served on this committee for 13 years and been struggling with ostriches around here to try to get them to let us carry on with our testing and modernization so that we could continue to keep the peace and it is gratifying to me, and I thank you gentlemen for the jobs that you do.

We have worked with Dr. Wagner for a long time. Dr. Perle, we appreciate what you do. You make our job easier when you give us such a candid and factual statement. Thank you very much.

Mrs. **Byron**. I have a couple of questions for Dr. Wagner.

Why would a comprehensive test ban hurt our ability to maintain an effective nuclear arsenal more than it would the Soviets? Wouldn't it hinder them also?

### COMPREHENSIVE TEST BAN EFFECT ON NUCLEAR ARSENAL

Dr. **Wagner**. Madam Chairman, I don't believe such a ban would hinder the Soviets as much as it would hinder us. I believe we depend much more on technology because of the constraints of our society and our strategic objectives and because of the way we have developed the delivery systems that carry the warheads in contrast with the way the Soviets have developed theirs. Thus, even if verified and complied with, a comprehensive test ban would be to the net advantage of the Soviet Union.

Mrs. **Byron**. I understood that our nuclear testing has permitted us to reduce the total number of megatons on the stockpiles since the early sixties and yet the number of warheads really hasn't decreased, has it?

Dr. **Wagner**. The number of warheads has actually come down also since that period of time, perhaps 20 percent or so, and both of those changes—the reduction in the necessary yield and the ability to provide deterrence with fewer warheads—derive in large part from the advances achieved by nuclear testing reflected in the warhead designs.

Mrs. **Byron**. Well, looking at one other aspect of where we are going with the test ban, and that is the people problem, do you feel that the fact that we have such an outstanding group of young scientists working in this field, doesn't the fact that you are working on a project and then all of a sudden you come up to the timeframe when you need to move forward with a test, doesn't that have detrimental effects on our ability to really retain what our experiences are?

I think there were indications that during the 1958-61 moratorium that we lost some extremely talented people in our programs.

Dr. **Wagner**. That was, in fact, the case during the moratorium and I am sure it would be the case again. A really good scientist, the kind we have to have working in these programs, derives his satisfaction from the challenge of comparing his understanding——

Mrs. **Byron**. You mean it is not the salary?

Dr. **Wagner** [continuing]. Against nature, and the inability to test would take that challenge and that stimulus away from those good people at the laboratories, and they would leave, there is no question about that.

Mr. **Perle**. This is another one of the many asymmetries with the Soviet Union. The Soviets would simply instruct their scientists and engineers to stand by if necessary for however long it takes. Andrei Sakahrov has indicated that he was called in and told he would work on the hydrogen bomb, which he did; he didn't have any choice in the matter.

We obviously cannot dictate to our citizens. This bears on SDI as well, and I believe it is one of the reasons why the President is so clear about his unwillingness to compromise SDI research and development. When you ask the scientists and engineers—on whom the success of a program like SDI depends—to invest their time and energy and talent and to dedicate their careers to such a project, they are entitled to some reasonable confidence that the rug is not going to be pulled out from under them in midstream. They should have some confidence that those years of toil in the laboratories will not go down the drain because some abrupt political decision has been made to reverse field and abandon that project.

The same applies to industry which has to decide how deeply to involve itself in Government programs. If programs are ephemeral, then the commitment of corporate resources will inevitably produce losses and failure. So it is important to demonstrate a delicate thing in a sense that a program like the SDI or nuclear testing program is going to be supported by the Government consistently, because it is important to the Nation and is vital to the success of those programs. To trifle with that climate of confidence about the programs would do great damage even if no negotiation ever was consummated.

Mrs. **Byron**. Mr. Badham, do you have any questions?

Mr. **Badham**. No.

Mrs. **Byron**. Mr. Ray. Mr. Stratton.

I want to thank you gentlemen very much for your testimony today. It has been once again outstanding and extremely helpful to us in trying to wade through the multitude of problems in this area and give us a better understanding of many of the difficulties we are dealing with.

Thank you again.

Secretary Hoover.

## STATEMENT OF HON. WILLIAM W. HOOVER, ASSISTANT SECRETARY FOR DEFENSE PROGRAMS, DEPARTMENT OF ENERGY, ACCOMPANIED BY HON. RICHARD L. WAGNER, ASSISTANT TO THE SECRETARY OF DEFENSE FOR ATOMIC ENERGY

Dr. **Wagner**. Madam Chairman, General Hoover has invited me to stay at the table. With your permission, I will——

Mrs. **Byron**. I didn't know what your timeframes were.

Dr. **Wagner**. With me this morning from the Department of Defense is Mr. Ralph W. Alewine who is prepared to address in considerable detail based on his expertise the issues related to the verification of test bans by seismic means, if you have questions in that area.

Mrs. **Byron**. Does he want to proceed to the table now?

Mr. **Hoover**. With your permission, I would like to submit my prepared statement for the record and briefly summarize. I believe a number of the points in my prepared statement have been covered by my colleagues and in the questions and answers.

It is a pleasure to appear before this committee and I think the task of this hearing, to draw out some of the reasons that might underlie why we should have reservations about a nuclear test ban, is certainly meritorious on your part.

### DOE RESPONSIBILITY

As you know, the DOE has the statutory responsibility for research, development, testing, and production of nuclear weapons. As Assistant Secretary for Defense Programs, I have those weapons programs under my jurisdiction.

We are all keenly aware of the heavy responsibility that accompanies these tasks which entail development of the most destructive weapons that mankind has devised. It should go without saying that no serious or even sane person would consider using these weapons to start a war.

In the 40 years of their existence, they have been used only to end a war. Their fundamental purpose is to keep the peace. It is in that context that we address the question of a nuclear test ban: Would it serve the cause of world peace?

Those of us in the Department of Energy who have studied this problem for many years have serious reservations about whether a nuclear test ban would serve that cause. We are concerned that by casting doubt on the reliability and effectiveness of our nuclear deterrent, a test ban could make war more likely rather than less.

First, a comprehensive test ban would prevent the modernization of our nuclear weapons force and the study of potential future weapons.

Second, it would limit our ability to certify and maintain the reliability of the weapons currently in our nuclear stockpile.

Third, it would have asymmetrical effects on the United States and the Soviet Union, the result of which would be a weakening of this country's military position.

And fourth, it could have an adverse, rather than beneficial, impact on some important arms control problems.

Dr. Wagner testified to some of the importance we place on modernizing our warheads. Certainly paramount in that modernization is that we know how today to build warheads in a safer, more tamper-proof mode than some of the older warheads. Even in the existing warheads, we need to be able to conduct nuclear tests if we are to maintain the confidence in their continuing reliability.

A nuclear warhead contains much chemically reactive material and is subject to the effects of aging and corrosion. I would commend to your reading a document entitled "Some Little Publicized Difficulties With a Nuclear Freeze," by Jack Rosengren, which documents in an unclassified manner some problems that we have had with warhead development in our weapon stockpile in the past, and where without nuclear testing we would have much less confidence in the reliability of our deterrent force.

Proponents of a nuclear test ban or freeze commonly preface their proposals with the words "mutual and verifiable." In reality, the nuclear test ban we believe would be neither mutual nor fully verifiable.

Most experts would agree that a test of 40 or 50 kilotons could almost certainly be detected, but it is equally certain that tests below 1 kiloton could be successfully hidden.

In any event, it is certain that some small tests and probably an occasional big one could be conducted covertly. Thus, the other side could continue to conduct low-yield nuclear experiments. They could test some new design theories. They might be able to test the primary or "trigger" stages of new weapons. Today, such tests might have only marginal importance; but they would be of great significance to the Soviet program during a period when the United States was doing no testing whatsoever.

### TEST BAN RESTRICTS R&D

My final point about a nuclear test ban has to do with our whole approach to the subject of arms control. A test ban restricts research and development; it does not control the level of armaments. In virtually all other areas of arms control negotiation, we have taken the position that arms control should not control research and development.

We know that testing is an integral part, an essential part of our nuclear research and development program. We do not believe that controlling or restricting that process is a reasonable way to proceed toward arms control. It would do nothing whatsoever to reduce the number of nuclear weapons deployed in the world.

In summary, we believe that adoption of House Joint Resolution 3 or H.R. 3100 would pose serious dangers to the United States. Specifically, a nuclear test ban would place the effectiveness of our nuclear deterrent at risk without symmetrically affecting that of the other side. We believe it represents poor arms control, in that it provides no reduction in the sizes of the two nuclear arsenals. While we realize that it is seen by many as an important symbol of arms control, we do not see that it has any value beyond symbolism.

We do not believe we need to be apologetic about what is in reality one of the great success stories of human history: The successful deterrence of major war, through nuclear weapons, for 40 years. Nuclear testing has played an important role in that historical event and should not be prohibited for the sake of ineffective symbolism.

Thank you.

Mrs. BYRON. Thank you very much.

### PREPARED STATEMENT OF HON. WILLIAM W. HOOVER

Representative Byron, members of the panel, distinguished guests: I sincerely appreciate the opportunity to present the views of the Department of Energy on a nuclear test ban. As you know, the Department of Energy has the statutory responsibility for research, development, testing, and production of nuclear weapons. As Assistant Secretary for Defense Programs, I have those weapons programs under my jurisdiction. This includes funding and programmatic oversight for the Livermore, Los Alamos, and Sandia National Laboratories and the Nevada Nuclear Test Site. We are all keenly aware of the heavy responsibility that accompanies these tasks, which entail the developments of the most destructive weapons ever devised by mankind, and yet weapons that are utterly essential in today's world for the preservation of peace. It should go without saying that no serious or even sane person would consider using these weapons to start a war. Their fundamental purposes today is to keep the peace. It is in that context that we address the question of a nuclear test ban: would it serve the cause of world peace?

Those of us in the Department of Energy, who have studied this problem for many years, have serious reservations about whether a nuclear test ban would serve that cause. We are concerned that a test ban could greatly limit our ability to respond to varying military challenges. We are concerned that, by casting doubt on the reliability and effectiveness of our nuclear deterrent, a test ban could make world war more likely rather than less. And we are concerned that a test ban would have the effect of weakening this country with respect to others who might not share our own desires for a free and peaceful world. To amplify on these concerns, let me address four specific points. First, a comprehensive test ban would prevent the modernization of our nuclear weapons force and the study of potential future weapons. Second, it would limit our ability to certify and maintain the reliability of the weapons currently in our nuclear stockpile. Third, it would have asymmetrical effects on the United States and the Soviet Union, the result of which would be a weakening of this country's military position. And fourth, it could have an adverse rather than beneficial impact on some important problems of arms control.

First of all, why do we conduct nuclear tests? We have several objectives: To modernize or modify nuclear explosives for new weapon systems; to make weapons safer, lighter, more tamper-proof, and more sparing in the use of nuclear materials; to investigate nuclear explosion effects on military systems and communications; and to better understand the physical phenomena of nuclear explosions. I am well aware that many proponents of a test ban do not see these as desirable objectives. On the contrary, they see one objective of a test ban as being the prevention of new weapons development. This, I think, is an emotionally attractive argument, but one that ignores what we have learned from the past 40 years of world history. During that period, nuclear deterrence has been a success story virtually without historical precedent—deterring not merely nuclear attack, but any aggression by one nuclear power against another. In Europe particularly, the nuclear deterrent has brought the longest period of peace in the history of Western civilization. During that time, the shape of nuclear deterrence has changed in response to technological developments and in response to the threats from others. We have developed nuclear weapons of differing size and character depending on the needs of the time. Back in the 1950s, modernization of the arsenal generally meant bigger bombs. By 1960, the total destructive potential in our arsenal was actually four times as great as it is today. Those huge weapons were needed to deter war in conjunction with the delivery systems of the day. During the 1960s, smaller missile systems such as the Minuteman, Polaris, and Poseidon demanded smaller and more efficient warheads. Today, the military requirements for attacking hardened targets have led to the development of new, extremely accurate missiles with their own unique constraints on warhead size and shape. Meanwhile, the need for warheads in other applications, such as air defense, has risen and fallen over the years. It would be most naive of us to assume that the military needs of 1995 are going to be the same as those of 1985. Discarding our capability to meet those needs would not serve the cause of peace. We should also be aware that modernization does not affect only weapon effectiveness: it also affects safety. Modern weapons incorporate explosive materials that are less susceptible to accidental detonation; they permit reduced radiation levels for nearby personnel; and they incorporate safeguards to prevent any accidental or unauthorized use. All these improvements require new weapon designs, and these designs must be tested. Testing is an essential indispensable part of the research and development process.

My second point is that even in the case of existing weapons, we need to be able to conduct nuclear tests if we are to maintain confidence in the continuing reliability of those weapons. A nuclear weapon contains much chemically reactive material, and is subject to the effects of aging and corrosion just as any other structure. In the history of our nuclear weapons program, we have discovered many cases in which weapons could have failed as a result of such problems. It is certain that a test ban would exacerbate the situation; we know this as a result of our last experience with an extended moratorium in 1959–61. Certain warheads introduced during that moratorium were subsequently found, after the resumption of testing, to have fundamental design flaws. They would not have worked. We have distributed some reading materials to the panel that document the history of our experience with these reliability problems. Now it is true that in many cases problems can be discovered and apparently resolved by non-nuclear inspections and tests. In other cases, though, remedial actions involving the nuclear components themselves can be confirmed only through nuclear testing. Contrary to what has sometimes been suggested, rebuilding warheads according to design specifications from several years in the past is generally not feasible—for example, because of unavailability of materials or manufacturing facilities. Likewise, the individuals who originally designed and built a weapon are likely to be unavailable when it comes time for reconstruction years later. Finally, there is an inevitable problem of human nature: when technology gives us the capability of doing a job in a better way, there is an almost irresistible temptation to make the improvements. That's fine—so long as the improvements can be tested. All of these considerations lead us to the general conclusion that we cannot, over an extended period of time, provide complete assurance of the reliability of weapons without being able to test them. Once again, I am well aware of the arguments of those who say that is a good thing—that the world would be a safer place if nuclear weapons weren't so reliable. I need only ask whether you would really trade the peace and stability of the last 40 years for a period in which war just might be deterred by weapons that might or might not work the way they are supposed to. We are working with situations that are far too dangerous to accept that kind of uncertainty.

Proponents of a nuclear test ban or a nuclear freeze commonly preface their proposals with the words "mutual and verifiable." My third point today is that in reality a nuclear test ban could be neither mutual nor fully verifiable. Often, this results from fundamental cultural differences: we know from direct negotiating experience that practices we would view as unacceptable or even illegal would be treated by the Soviet Union as being allowable within the context of specified treaty provisions. These considerations have resulted in considerable attention devoted by us to the subject of verification. When we talk about verifiability, we are basically asking: can the other side get away with clandestine testing in violation of a test ban? Our experience with the detection of underground tests gives an indeterminate answer—yes if it's a very small test, no if it's a very big one. But you quickly get bogged down in a numbers game when you try to draw the line between small and big. There are many factors—just how the test is conducted and just how it is monitored—that determine whether an underground test can be detected or not. Most experts would agree that a test of 40 or 50 kilotons could almost certainly be detected; but it is equally certain that tests below one kiloton could be successfully hidden. In any event, it is certain that some small tests and probably an occasional big one could be conducted covertly. Thus, the other side could continue to conduct low-yield nuclear experiments. They could test some new design theories. They might be able to test the primary or "trigger" stages of new weapons. Today, such tests might have only marginal importance; but they would be of great significance to the Soviet program during a period when the United States was doing no testing whatsoever.

There are other reasons why we believe that a test ban would have more of an effect on this country than on the Soviet Union. The delivery systems used by this country have always been smaller than their Soviet counterparts. We have carefully optimized our warhead designs to accommodate those capabilities. But it is precisely that optimization that has forced us to the more sophisticated designs that are most sensitive to precise manufacturing characteristics, and most in need of testing to verify that the often subtle effects of design decisions are really the same as what has been theoretically predicted. If the Soviet designs are more rugged than ours, because of the conservative approach made possible by the weapons' greater weight, then they are also less dependent on testing. There are also other asymmetries. If the Soviet Union were to develop problems with their own stockpile, their closed society will make it far easier for them to conceal the existence of such problems for geopolitical advantage. The Soviet Union also has far more control over its work force. In anticipation of a possible end to a test ban or moratorium, they could direct their scientists and engineers to remain in the weapons design business. We, of course, cannot do that, and our experience indicates that within a few years of a test ban many of our top weapons scientists would be moving into work with more professional opportunity. Finally, the Soviet Union could conduct illegal tests in other areas, notably in far outer space. Such tests would not be exorbitantly expensive, and would then be virtually unrestricted in terms of yield. If it were masked by the sun, for example, a test of many megatons could go undetected. We of course do not know whether any of these possibilities would actually come about. I point them out merely to indicate that talk about a "mutual and verifiable" test ban has to be looked at with a certain amount of skepticism. The effects of such a ban are not likely to be mutual, and the ban is not going to be fully verifiable.

My final point about a nuclear test ban has to do with our whole approach to the subject of arms control. A test ban restricts research and development; it does not control the level of armaments. In virtually all other areas of arms control negotiation, we have taken the position that arms control should not control research and development. The ABM treaty, for example, restricts deployment of weapons but explicitly permits continued R&D. In the case of nuclear weapons, we have seen that testing is an integral, essential part of the R&D process. We do not believe that controlling or restricting that process is a reasonable way to proceed toward arms control. It would do nothing whatsoever to reduce the number of nuclear weapons deployed in the world. It might even result in an increase in such numbers: if weapons are believed to be less reliable, there will be a tendency on the part of military planners to demand more of them in compensation. Newer mobile and survivable weapons, of special interest because of their stabilizing effect on the strategic balance, could be unavailable to us in the presence of a test ban. This would further exacerbate an existing imbalance that favors the Soviet Union in that area. We cannot see that a test ban would be beneficial in terms of restricting nuclear arms, and we can see many ways in which it could be detrimental.

These considerations suggest an important point that deserves special attention. We sometimes tend to focus too much on the "costs," or potential disadvantages of a test ban without looking as critically at the other side of the ledger: what are the benefits of a test ban? We believe that those benefits are largely symbolic, to the extent that they exist at all. Most proponents of a test ban see it as advantageous that a ban would prevent modernization of nuclear arsenals, thus slowing the nuclear arms race. Our view is that so long as geopolitical realities force us to rely on a policy of nuclear deterrence, it is foolish for us to do anything other than develop the best, most reliable, and safest weapons that we can. Other proponents have argued that modern weapons could be developed to use existing or off-the-shelf warheads. We would argue first, that such adaptation is rarely possible without at least some nuclear testing, and second that we should not regard ourselves as having the perfect foresight that will let us know just what weapons we will require in the future years. Proponents of a test ban have in some cases argued that the decrease in our stockpile reliability would be beneficial, in that reduced reliability would lessen the likelihood of nuclear weapon use. We would argue that this, again, ignores the policy of nuclear deterrence on which world peace has depended for four decades. Without the credible threat of response with reliable and effective nuclear weapons, we believe that we would be increasing the risk of non-nuclear conflict between the superpowers—conflict that could very possibly escalate to the nuclear level anyway as soon as one side sees itself as losing. These considerations, in our judgment, reduce the test ban to the role of a possible confidence-building measure, a gesture which might lead to further steps toward more meaningful disarmament. Even this advantage is highly speculative: a test ban could well lead us away from further arms reductions as both sides, doubting the reliability of their nuclear weapons, might increase their numbers. Thus, we see no value beyond symbolism in such a ban. Our argument is not only that there are serious risks in a test ban, but that in reality there are few if any compensating benefits.

Although I have addressed my comments today to the subject of a nuclear test ban, it should be clear that the same concerns apply with even greater strength to more extreme proposals such as those of H.R. 3100 to freeze production; of nuclear weapons. Contrary to the statement of that bill that a freeze would "improve the deterrent effectiveness of existing nuclear forces," we are convinced that such a freeze would have a significant detrimental impact on the very existence of the deterrent. Our effects to maintain our stockpile weapons utilize the same facilities, technologies, and personnel as do our efforts in developing new weapons. Without being able to produce new components or remedy reliability problems that may appear in the future, we cannot avoid increasing degradation of performance and, ultimately, loss of weapon capabilities altogether. Efforts to improve safety and security provisions in our weapons would of course also suffer from a freeze, as would our ability to retain our uniquely talented cadre of scientific and technical expertise.

In summary, then, we believe that a nuclear test ban poses serious dangers for the United States. It would place the effectiveness of our nuclear deterrent at risk, without symmetrically affecting that of the other side. It represents poor arms control, in that it provides no reduction in the size of the two nuclear arsenals. While we realize that it is seen by many as an important symbol of arms control, we do not see that it has any value as an important symbol of arms control, we do not see that it has any value beyond symbolism. On the contrary, we think that it would have the wrong impact on our whole policy of nuclear deterrence. I am not trying to suggest that "nuclear weapons are good for you;" like everyone else, I would like to see the day when they can safely be eliminated completely. But I do believe that we need to stop being apologetic about what is in reality one of the great success stories of human history: the successful deterrence of major war, through nuclear weapons, for 40 years. Nuclear testing has played an importance role in that historical event and should not be prohibited for the sake of ineffective symbolism. Thank you.

Mrs. BYRON. Do you want to give us your statement: and then we will go with questions for all three of you.

## STATEMENT OF DR. RALPH W. ALEWINE III, ASSISTANT DIRECTOR, GEOPHYSICAL SCIENCES DIVISION, DEFENSE ADVANCED RESEARCH PROJECT AGENCY

Dr. ALEWINE. Thank you.

Madam Chairman, and distinguished members of the panel. I would like to begin by thanking you for the opportunity to discuss the status of Department of Defense research and development activities to improve national capabilities to detect, identify, and determine characteristics of foreign nuclear explosions.

Within the Department of Defense, the responsibility for these research and development activities has been assigned to the Defense Advanced Research Projects Agency [DARPA].

DARPA's charter includes responsibility for basic research and development to solve fundamental problems of nuclear test monitoring, as well as providing scientific support to U.S. nuclear test and activities, such as was the case in the Threshold Test Ban Treaty and the Peaceful Nuclear Explosion Treaty in the mid-1970's, and the Comprehensive Test Ban Treaty negotiations in 1977 through 1980, and more recently, to the Conference on Disarmament.

### STATUS OF VERIFICATION TECHNOLOGY

My statement today concerns the status of technology for verifying compliance with a nuclear test ban treaty. I have distributed copies of a prepared statement on this status to the panel; and, with your permission, Madam Chairman, I will briefly summarize it to stay within the allotted time.

The principal scientific tools for monitoring nuclear test ban treaties are seismic networks, surveillance satellites, sampling of radioactive debris and on-site inspections and measurements. The Department of Defense has conducted research into all of these areas, however, at the present time, seismological methods are the primary means for the detection of such tests and the determination of yield.

Other remote sensing means are likely to play a critical role by providing corroborating evidence of a treaty violation.

A key point that I would like to leave with you today is that the verification of any nuclear test limitation agreements must be based on solid technical grounds. From a monitoring perspective, it is especially important that this technical foundation be established either before or concurrent with consideration of such agreements.

Developing the foundations for verification technology ex post facto can lead to serious difficulties, such as we are currently experiencing with the 150-Kiloton Threshold Test Ban Treaty.

Prior to the time this treaty was negotiated U.S. policy was specifically aimed at seeking a Comprehensive Test Ban Treaty, and therefore, research on developing the methodology to achieve the level of yield accuracy required was a relatively neglected research area. As a result, the research base was insufficient to anticipate the yield estimation problems which subsequently have arisen with monitoring this treaty.

As a result of an intensive research effort, the technology and scientific basis for monitoring the Threshold Test Ban Treaty has advanced considerably since the time the treaty was negotiated. Improvements to our monitoring techniques have been made, and are continuing.

However, these unilateral improvements are inherently limited by the lack of sufficiently complete and reliable geophysical information concerning the Soviet nuclear test sites. If the uncertainties in our yield estimates are to be significantly reduced, more direct information is needed than is currently available, or would be available if the Threshold Test Ban Treaty were ratified.

The Soviets and others in this country have suggested that adequate verification of the Threshold Test Ban Treaty will result from the exchange of the data called for when the treaty is ratified. Unfortunately, these data will be of limited use unless they can be independently verified.

Even if these data were verified, they would not provide the information to achieve the required yield accuracies.

In the Comprehensive Test Ban Treaty talks of 1977 through 1980, the discussions focused on three verification measures which would be placed into operation to supplement the national technical means of each country. These were: A network of seismic stations and arrays in the United States, the United Kingdom, and in the Soviet Union, specifically designed for treaty monitoring purposes; a system of international seismic data exchange which would draw upon the work of the Conference on Disarmament; and, a provision for limited on-site inspections.

## MONITORING UNDERGROUND NUCLEAR EXPLOSIONS

The fundamental technical basis for monitoring underground nuclear explosions has not changed dramatically over the past decade. However, there have been some important changes in capability resulting from steady progress in our research program in geophysics and explosion seismology.

With agreement in principle during the Comprehensive Test Ban Treaty talks to establish seismic stations on Soviet territory, research has been redirected toward methods based on the use of data collected at regional distances—that is less than 2,000 km—from events of interest. Signals from these shorter distances turn out to be much more complicated than those from the longer ranges, but they can be exploited for the detection of much smaller events. It is these complicated signals that we must use from stations inside the Soviet Union.

The most dramatic improvements in seismic monitoring capability have been in two major areas: Data collection capabilities and development and implementation of automated and more powerful data processing techniques.

Promising new technology is being exploited as quickly as possible. Improved sensors developed in this program have been incorporated by the Department of Energy into engineering prototypes of seismic stations which could be used inside the Soviet Union or elsewhere.

A network of these stations have been deployed in the United States and Canada for test and evaluation purposes. The digital data from these stations are broadcast directly by satellite to a DARPA research facility, where they are used to test the automated data handling methods under development.

The ability to handle the large volumes of data from a network of stations inside the Soviet Union is reasonably advanced.

Under the auspices of the Conference on Disarmament [CD] work has continued on the development of methods for international seismic data exchange. The concept is to collect, organize, and make available seismic data voluntarily submitted by existing seismic stations at many locations around the world.

With the support of the Department of Defense research program, the United States has been very active in introducing advanced technical methods into the proposed international system. With our backing, the CD undertook last fall a 2-month test of elements of the proposed system.

Altogether, more than 37 countries took part, contributing data from almost 80 globally distributed seismic stations. Prototypes of international data centers were established in Washington, Stockholm, and Moscow to receive and analyze data from the network.

The Washington International Data Center used the facilities of the DARPA research center and made extensive use of the unautomated data acquisition and processing methods developed for monitoring purposes. An evaluation of this test is now underway by the CD, but it is clear that a number of deficiencies must be corrected and the overall technology upgraded before such a system can play any meaningful role in a nuclear test ban situation.

During this international data exchange experiment, a number of nuclear explosions in the Soviet Union, French Polynesia, and the United States were detected and reported. However, the Soviet Union, contrary to the agreed procedures, withheld data from all their nuclear tests.

Such actions reinforce the the long-held United States position that any verification arrangement for seismic installations inside the Soviet Union must have the provision for direct access to the data produced by those stations.

It has been known for some time that special measures might have to be employed to achieve effective monitoring in the Kurile-Kamchatka area of the Soviet Union. An experiment was successfully conducted, using the drill ship *Glomar Challenger* to implant the sensors and recording systems, beneath the seabed in international waters, to demonstrate that effective monitoring data could be obtained from carefully chosen sites in the deep ocean.

The results of this experiment open large new areas of the world, previously considered inaccessible, to installation of high quality monitoring stations.

One promising development in the research program has been the design and testing of a prototype advanced seismic array. Such arrays offer the potential of providing much greater sensitivity for signal detection than any existing station.

After several years of design and experimentation the array began operation in a research mode earlier this year in southern Norway, an area which is thought to be geologically similar to the western part of the U.S.S.R.

Initial indications are that the array can achieve about an order of magnitude improvement in signal detection capabilities in the regional range of interest. A full evaluation and exploitation of these results is underway.

One major objective of research efforts discussed thus far has been to reduce the threshold for signal detection to as low a level as possible. This is the area in which the research program has been most successful.

For example, if the monitoring objective is to detect all nuclear tests as small as 1 kiloton or more, it now appears that a detection threshold of about magnitude 2.5 is required.

At the present time, we have insufficient information about the geophysical characteristics of the Soviet Union to determine with any certainty the exact number and placement of seismic monitoring installations which would be necessary to achieve such a monitoring goal.

At the present time in our research program, the capability developed to detect small events has far exceeded our capability to differentiate small, or muffled, nuclear explosions from natural seismic events. This is especially true, when only the complex data from regional distances are available.

It has been estimated that, based on the technology available today, at least 1,000 natural seismic events per year at the 1 kiloton monitoring level would require special attention and analysis.

With the current capability to discriminate between nuclear explosions and earthquakes, a significant fraction could not be confidently identified as nonnuclear. Some of these would actually be earthquakes that have seismic characteristics that do not easily distinguish themselves from explosions, and some would be chemical explosions which are an especially difficult problem.

The difficulty in monitoring a comprehensive test ban treaty is dealing with the threat of a determined evasion attempt, that is, a clandestine nuclear test. The safest way to attempt clandestine underground testing is to design the test to produce seismic signals which are below the detection capability of the monitoring network. The most effective way to reduce seismic signals is to conduct the nuclear explosion in a large underground cavity, so-called cavity decoupling.

Large cavities, which can be used to reduce the signals of militarily significant yields, are not uncommon and can be constructed most easily in areas of underground salt deposits. Such areas are quite extensive in the Soviet Union.

The United States has long recognized the threat imposed by the cavity decoupling method and has fully taken this into account in our monitoring capability estimates. There are indications that the cavity decoupling evasion method loses its effectiveness at frequencies higher than those now normally used for signal detection.

Thus, if these high frequencies can propagate efficiently over certain paths, it may be possible to reduce the effectiveness of this evasion scheme in some circumstances. We are now collecting and evaluating such high frequency data from events originating in the Soviet Union to test this hypothesis. Much is left to be learned about this.

It is known that the Soviets have conducted a number of nuclear tests in areas where cavity decoupling is possible. They certainly have information on the propagation of high frequency energy in these regions. Such information, if available to the U.S. research program, would greatly reduce our uncertainties about the effectiveness of this evasion possibility and contribute to a better understanding of our verification capabilities.

One should bear in mind that no realistic seismic verification system will be able to monitor a zero yield test ban with anywhere near 100 percent certainty. We also must realize that seismic evidence by itself cannot provide all of the stringent data that will be required to ensure compliance.

A realistic goal for our research program has been to provide the technology to deter cheating by maintaining a high probability of detecting and identifying nuclear tests of militarily significant yields. It is important that any verification measure be viable and contribute to confidence building by minimizing the number of natural earthquakes and man-made nonnuclear events—for example chemical explosions—that could be mistaken for nuclear explosions.

A comprehensive test ban would be, from a monitoring point of view, a low-yield threshold treaty with a vague and undefined threshold. As we have found out, monitoring the current 150-kiloton limitation on testing, which demands the precise determination of yield, is a very complex undertaking and requires considerable information about the geophysical conditions near the explosion site.

Direct determination of yield by measuring the hydrodynamic shock front can provide a relatively precise yield estimate for underground tests. This method was discussed in the PNET negotiations and more recently by President Reagan as a means for improving the verification of the current 150-kiloton limit on testing.

### R&D PROGRAM TO IMPROVE VERIFICATION

In summary, the Department of Defense has been conducting a vigorous research and development program to improve nuclear test ban verification capabilities. Technology is being developed and improved, both for existing monitoring resources and for potential systems, whose installation in the Soviet Union which would have to be negotiated.

The amount of improvement such facilities in the U.S.S.R. would provide depends on the number and siting of the installations, on the actual geophysical conditions within the U.S.S.R., and other factors. At the present time, the research efforts are handicapped by the lack of adequate geophysical and seismological data from key regions in Eurasia.

Any action to make such data available would provide a major contribution to the effort to improve our seismic monitoring capabilities.

There remain problems in detecting and, especially, identifying underground nuclear tests, particularly if they are carefully designed for evasion. Until these problems are solved, there will exist a degree of risk. The potential for deliberate evasion must be balanced with stringent verification measures to reduce these risks, which should not be understated.

These are the key problems to which our research efforts are directed, and we are taking them seriously. The final decision on any nuclear test ban proposal must rest on the determination of whether or not such a proposal is in our national interest. Mr. Perle and Dr. Wagner have already spoken to this issue.

This completes the summary of my prepared remarks. I will be happy to answer any questions you may have.

# Prepared Statement of Dr. Ralph W. Alewine III

Madam Chairman and distinguished members of the Panel. I would like to begin by thanking you for the opportunity to appear before you to discuss the status of Department of Defense research and development activities to improve national capabilities to detect, identify, and determine characteristics of foreign nuclear explosions. Within the DoD, the responsibility for these research and development activities has been assigned to the Defense Advanced Research Projects Agency (DARPA). DARPA's charter includes responsibility for basic research and development to solve fundamental problems of nuclear test monitoring, as well as providing scientific support to U.S. arms control activities. The objective of these latter activities is (1) to develop improved methods for monitoring current nuclear test limitation agreements; (2) to develop new technical verification options for consideration by U.S. policymakers in future agreements; and (3) to provide technical support for ongoing negotiations such as was the case in the Threshold Test Ban Treaty and the Peaceful Nuclear Explosion Treaty in the mid-1970's, and the Comprehensive Test Ban Treaty negotiations in 1977 through 1980. More recently, DARPA has been providing technical support and expertise for the U.S. delegation to the Conference on Disarmament in their discussions and activities related to nuclear test issues.

My statement today concerns the status of technology for verifying compliance with a nuclear test ban treaty. The principal scientific tools for monitoring nuclear test ban treaties are seismic networks, surveillance satellites, sampling of radioactive debris and on-site inspections and measurements. The DoD has conducted research into all of these areas, but today I will confine my remarks to our program in seismic monitoring.

In recent years, the emphasis of verification research has been on improving the capability to detect and identify underground nuclear tests and on determining their yields. Currently, seismological methods are the primary means for the detection of such tests and the determination of yield. Other remote sensing means are likely to play a critical role by providing corroborating evidence of a treaty violation. Therefore, it will be necessary to verify compliance in all environments: that is, in the atmosphere, in space, and in the oceans. Unlike underground nuclear tests, there is the additional problem of unambiguously attributing a detected nuclear explosion to the responsible nation.

A key point that I would like to leave with you today is that the verification of any nuclear test limitation agreements must be based on solid technical grounds. From a monitoring perspective, it is especially important that this technical foundation be established either before or concurrent with consideration of such agreements. Developing the foundations for verification technology ex post facto can lead to serious difficulties.

As a case in point, the Threshold Test Ban Treaty was negotiated with the Soviet Union in 1974 and set a 150-kiloton limit on the maximum size of underground nuclear explosions. Some provisions were made in the protocols of the treaty for the exchange of geophysical data and yields of two calibration explosions to aid in the monitoring of this treaty. Since the only practical way to estimate the yield of Soviet underground nuclear tests at that time were seismological techniques, it fell to this method to serve as the primary monitoring tool. Prior to this time, U.S. policy was aimed at seeking a Comprehensive Test Ban Treaty and, therefore, research on developing the methodology to achieve the level of yield accuracy required was a relatively neglected area. As a result, the research base was insufficient to anticipate the yield estimation problems which subsequently have arisen with monitoring this treaty.

As a result of an intensive research effort, the technology and scientific basis for monitoring the Threshold Test Ban Treaty has advanced considerably since the time the treaty was negotiated. Our understanding about the processes which affect yield estimation has increased and additional measurement techniques have been developed which can be used for on-site verification of the yields. Improvements to our monitoring techniques have been made and are continuing. However, these unilateral improvements to the current methods are inherently limited by the lack of sufficiently complete and reliable geophysical and other information concerning the Soviet nuclear test sites. If the uncertainties in our yield estimates are to be significantly reduced, more direct information is needed than is currently available, or is specified for exchange in the current treaty protocols.

The Soviets and others have suggested that adequate verification of this treaty will result from the exchange of the data called for when the treaty is ratified. Unfortunately, these data will be of limited use unless they can be independently verified. Even if these data were verified, they would not provide the required yield accuracies for other large tests.

In the Comprehensive Test Ban treaty (CTBT) talks of 1977 through 1980, the discussions focused on three verification measures which would be placed into operation to supplement the national technical means of each country. These were:

- a network of seismic stations and arrays in the U.S., the U.K., and in the Soviet Union, specifically designed for treaty monitoring purposes;
- a system of International Seismic Data Exchange which would draw upon the work of the Conference on Disarmament; and,
- a provision for limited on-site inspections.

Since the CTBT talks were suspended, research has continued to develop the technology base in each of these three general areas. Most of the recent efforts in on-site inspection technology have been undertaken by the Department of Energy national laboratories and will not be discussed in this statement.

In a comprehensive or very low yield test ban situation, as we shall see, there would be inherent risks in relying on seismological techniques to provide definitive evidence of a concealed underground nuclear explosion. It must be emphasized that seismological methods, by themselves, may not be able to provide sufficiently conclusive evidence of a carefully concealed nuclear test. However, the seismological data can be used very effectively to quickly detect and locate suspicious events so that other verification methods can be focused on them.

The fundamental technical basis for monitoring underground nuclear explosions has not changed dramatically over the past decade. The concepts underlying the detection and identification of explosions and the techniques which can be used to attempt to evade detection and identification remain generally as they were described in some detail in the mid-1970's. However, there have been some important changes in capability resulting from steady progress in our research program in geophysics and explosion seismology. We now have a more complete understanding of the nature of explosions and earthquakes as sources of seismic signals, as well as the effect of the earth's structure on the propagation of these signals.

Most of the research emphasis before 1980 was on methods for detecting, identifying, and characterizing explosions from seismic signals collected at long ranges. These are primarily the signals which we can record with existing national technical means (NTM) based on seismic stations outside the USSR. With agreement in principle to establish seismic stations on US, UK, and Soviet territory, research has been redirected toward methods based on the use of data collected at regional distances (that is less than 2,000 km) from events of interest. Signals from these shorter distances turn out to be much more complicated that those from the longer ranges, but they can be exploited for the detection of much smaller events. It is these complicated signals that we must use from stations inside the Soviet Union under a nuclear test ban treaty. One of the key topics for research is development of robust techniques to identify explosion-like events using these regional signals. Since the character of these signals depends on each specific region, this research is handicapped by the lack of adequate data from the Soviet Union.

The most dramatic improvements in seismic monitoring capability have been in two major areas: (1) data collection capabilities, that is, improved seismic instrumentation, electronics, and high dynamic range digital data recording; and (2) development and implementation of automated and more powerful data processing techniques. In reviewing this progress, a highlight is the development of ultra-sensitive seismometers with extremely great resolution and low noise electronics.

The shift to high quality digital data collection has made it possible to automate much of the data processing, and therefore to handle the large volumes of data that will be required with consistent procedures. The capability for automated processing and data analysis is still at a relatively early stage of development, but is being improved and demonstrated at a DARPA research facility in Arlington, Va.

This promising new technology is being exploited as quickly as possible. The improved sensors have been incorporated by the Department of Energy into engineering prototypes of seismic stations which could be used inside the Soviet Union or elsewhere. A network of these stations have been deployed in the U.S. and Canada for test and evaluation purposes. The digital data from these stations are broadcast directly by satellite to the DARPA Center, where they are used to test the automated data handling methods under development. The ability to handle the data from a network of stations inside the Soviet Union is reasonably advanced. In addition, this development is providing a thorough evaluation of the prototype seismic sensor systems.

Under the auspices of the Conference on Disarmament (CD) work has continued on the development of methods for "International Seismic Data Exchange." The concept is to collect, organize, and make available seismic data voluntarily submitted by existing seismic stations at many locations around the world. These data could be used by countries that do not possess sophisticated National Technical Means to monitor for major treaty infractions, and they could supplement U.S. monitoring systems in certain remote areas. With the support of the DoD research program, the U.S. has been very active in the development, specification, and testing of procedures that could be used for these purposes. We have undertaken a number of technical initiatives within the CD to improve the overall global monitoring capabilities and to introduce advanced technical methods into the proposed international system. With the firm backing of the U.S., the CD undertook last fall a two-month test of elements of the proposed system. Altogether, more than 37 countries took part, contributing data from almost 80 globally distributed seismic stations. Prototypes of International Data Centers were established in Washington, Stockholm, and Moscow to receive and analyze data from the network and to distribute the results to all participants. The Washington International Data Center used the facilities of the DARPA research center and made extensive use of the automated data acquisition and processing methods developed for monitoring purposes. An evaluation of this test is now underway by the CD, but it is clear that a number of deficiencies must be corrected and the overall technology upgraded before such a system can play a meaningful role in a nuclear test ban situation.

During this international data exchange experiment, a number of nuclear explosions in the Soviet Union, French Polynesia, and the U.S. were detected and reported by participating stations, and locations and magnitudes were determined by the Washington and Stockholm data centers. However, the Soviet Union limited its participation to a single seismic station and, contrary to the agreed procedures, withheld data from all Soviet nuclear tests. Such actions reinforce the long-held U.S. position that any verification arrangement for seismic installations inside the Soviet Union must have the provision for direct access to the data produced by those stations.

It has been known for some time that special measures might have to be employed to achieve effective monitoring in the Kurile-Kamchatka area of the Soviet Union. This is an area of concentrated military activities, as well high seismic activity, and thus an area where evasion must be considered a possibility. One promising approach for improving the monitoring capabilities in this area was to implant seismic sensors deep beneath the sea bed in international waters in the northwest Pacific. The technology in instrumentation, marine engineering, and deep sea drilling has only recently been developed to a point where such a challenging project could be undertaken. An experiment was successfully conducted, using the drill ship Glomar Challenger to implant the sensors and recording systems, to demonstrate that effective monitoring data could be obtained from carefully chosen sites in the deep ocean. The results of this experiment open large new areas of the world, previously considered inaccessible, to installation of high quality monitoring stations.

A highly promising development in the research program has been the design and testing of a prototype advanced seismic array. This new array, called Noress, offers the potential of providing much greater sensitivity for signal detection than any existing station. It also provides valuable information to help locate events. The superiority of such installations for the detection and identification of low-magnitude events in a test ban context is evident. After several years of design and experimentation in cooperation with scientists in Norway, the prototype Noress array began operation in a research mode earlier this year in southern Norway, an area which is thought to be geologically similar to the western part of the

USSR. This seismic research station, which is the most advanced in the world, has been specially designed to detect and locate signals of higher frequency which propagate in the regional distance range. Initial indications are that Noress can achieve about an order of magnitude improvement in signal detection capabilities in the regional range of interest. A very preliminary analysis indicates that the regional array has a detection threshold in the 2.5 to 3.0 magnitude range for certain regional paths extending into the Soviet Union. A full evaluation and exploitation of these results is underway.

Within the past decade, the research program has included a major effort to maintain and improve the global seismic monitoring capabilities and to provide a high quality data base for research and technique development. Eighteen advanced seismic observatories have been installed around the globe and other existing stations equipped with improved digital equipment. In addition, we have supported several international cooperative efforts to improve the available global data base for research purposes, including efforts with Australia and the Peoples Republic of China.

One major objective of the research efforts discussed thus far has been to reduce the threshold for signal detection to as low a level as possible. This is the area in which the research program has been most successful. For example, if the verification objective is to detect all nuclear tests as small as one kiloton or more, it now appears that a detection threshold of about magnitude 2.5 is required. At the present time, we have insufficient information about the geophysical characteristics of the Soviet Union to determine with any certainty the exact number and placement of seismic monitoring installations which would be necessary to achieve such a monitoring goal. Only rough estimates, based on imprecise assumptions, can be made.

In any case, a requirement for monitoring large portions of the entire Soviet Union at this level would be a formidable task in data processing and analysis because of the very large number of natural events of this size which occur. At the present time in our research program, the capability developed to detect small events has far exceeded our capability to differentiate small, or muffled, nuclear explosions from natural seismic events. This is especially true, when only the complex data from regional distances are available. It has been estimated that, based on the technology available today, at least 1,000 natural seismic events per year at the one kiloton monitoring level would require special attention and analysis. With the current capability to discriminate between nuclear explosions and earthquakes, a significant fraction could not be confidently identified as non-nuclear. Some of these would actually be earthquakes that have seismic characteristics that do not easily distinguish themselves from explosions, and some would be chemical explosions.

Chemical explosions pose an especially difficult problem for a low yield nuclear test ban treaty. A large number of them are routinely conducted for civil and engineering purposes. In fact, there are occasional chemical explosions with yields of several kilotons or more. Current seismic verification capabilities are not adequate to distinguish between chemical and low yield nuclear explosions, or to provide the assurance that a bona fide chemical explosion is not disguising a nuclear test. Barring some unforeseen technical breakthrough, some alternative provisions will be required to deal with this problem.

A signatory to a nuclear test ban who is determined to conduct clandestine nuclear tests could attempt to do so in any environment—in space, in the atmosphere, in the ocean, or underground. The safest way to attempt clandestine underground testing is to design the test to produce seismic signals which are below the detection capability of the monitoring network. The most effective way to reduce seismic signals is to conduct the nuclear explosion in a large underground cavity (cavity decoupling). Large cavities, which can be used to reduce the signals of militarily significant yields, are not uncommon and can be constructed most easily in areas of underground salt deposits. Such areas are quite extensive in the Soviet Union. Cavities of the volume required for such tests exist, although all may not have the optimum shape for decoupling. In the United States they are used for storing petroleum reserves. Foiling such an evasion attempt requires a very sensitive monitoring network which is reliably deployed. This threat is the primary reason for the need for high quality stations and arrays inside the Soviet Union.

The U.S. has long recognized the threat imposed by the cavity decoupling method and has fully taken this into account in our monitoring capability estimates. However, it must be said that the current understanding of the seismic effects of cavity decoupling is incomplete and is based on a relatively sparse set of experiments. Inconsistencies remain between actual experience and theoretical possibilities. A full-scale feasibility test of this concept was conducted a number of years ago using a small nuclear explosion, and data from this experiment have been supplemented with laboratory and numerical models and other theoretical work.

There are indications from this experience and from theory that the cavity decoupling evasion method loses its effectiveness at frequencies higher than those now normally used for signal detection. Thus, if these high frequencies can propagate efficiently over certain paths, it may be possible to reduce the effectiveness of this evasion scheme in some circumstances. Several years ago, we discovered through our research program that seismic energy does propagate very efficiently across the western portion of the Soviet Union, at least when the signals do not cross major geological boundaries. Stations deployed inside the Soviet Union could presumably take advantage of this. We are now collecting and evaluating such high frequency data from events originating in the Soviet Union to determine the propagation characteristics of very high frequency signals such as might leak out of a cavity-decoupled explosion. Much is left to be learned about this.

It is known that the Soviets have conducted a number of nuclear tests in areas where cavity decoupling is possible. They certainly have information on the propagation of high frequency energy in these regions. Such information, if available to the U.S. research program, would greatly reduce our uncertainties about the effectiveness of this evasion possibility and contribute to a better understanding of our verification capabilities.

A substantial number of high quality stations and arrays within the Soviet Union is necessary for effective counter evasion. Without these stations, evasion of the nuclear test ban would be relatively easy and with decoupling could involve explosions with fairly large yields, i.e., more stations and arrays, evasion would not be impossible, but it would be much more difficult, complex, and expensive, especially for yields greater than a few kilotons.

One should bear in mind that no realistic seismic verification system will be able to monitor a zero yield test ban with 100% certainty. We also must realize that seismic evidence by itself cannot provide all of the stringent data that will be required to ensure compliance. Other methods must supplement this system. A realistic goal for our research program has been to provide the technology to deter cheating by maintaining a high probability of detecting and identifying nuclear tests of militarily significant yields. It is important that any verification measure be viable and contribute to confidence building by minimizing the number of natural earthquakes and man-made non-nuclear event (for example chemical explosions) that could be mistaken for nuclear explosions.

A comprehensive test ban would be, from a monitoring point of view a low-yield threshold treaty with a vague and undefined threshold. Consideration of an explicitly defined low-yield threshold test ban rather than a comprehensive test ban presents a different set of verification problems. As we have found out in monitoring the current 150-kiloton limitation on testing, the precise determination of yield is a very complex undertaking which requires considerable information about the geophysical conditions near the explosion site. As the yield limit becomes smaller, the range of possible variation in emitted seismic signals grows larger. Direct determination of yield by measuring the hydrodynamic shock front can provide a relatively precise yield estimate for underground tests. This method could also provide a seismic calibration for small geophysically homogeneous sites and thus reduce the uncertainties of the seismically determined yield estimates of other tests. Such measures were discussed in the PNET negotiations and more recently by President Reagan as a means for improving the verification of the current 150-kiloton limit on testing.

In summary, the Department of Defense has been conducting a vigorous research and development program to improve nuclear test ban verification capabilities. Significant improvements to our monitoring capabilities have been made through the research and development effort and they are continuing. Technology is being developed and improved both for existing monitoring resources and for potential systems whose installation in the Soviet Union must be negotiated. If successfully negotiated, the installation of a number of high quality tamper-resistant seismic stations and arrays in the Soviet Union would significantly lower the verification threshold of a nuclear test ban treaty. The amount of improvement depends on the number and siting of the installations, on the actual geophysical conditions within the USSR, and other factors. At the present time, the research efforts are handicapped by the lack of adequate geophysical and seismological data from key regions in Eurasia. Any action to make such data available would provide a major contribution to the effort to improve our seismic monitoring capabilities.

As technical experts, it is our role to realistically portray the capability and limitations to monitor compliance with proposed nuclear test limitation agreements. This is crucial for assessing the risks. There are problems detecting and, especially, identifying underground nuclear tests, particularly if they are carefully designed for evasion. Until these problems are solved, they will present a degree of risk. The potential for deliberate evasion must be balanced with stringent verification measures to reduce these risks, which should not be understated. These are the key problems to which our research efforts are directed.

Any consideration of a nuclear test ban proposal must carefuly weigh the inherent limitations imposed on the monitoring capabilities. However, the final decision must rest on the determination of whether or not such a proposal is in our national interest. Mr. Perle and Dr. Wagner have have already spoken to this issue.

## EFFECT OF TEST BAN ON OTHER NATIONS

Mrs. **BYRON**. Thank you very much. I have a few questions.

Dr. Wagner, do you feel that a test ban by the Soviet Union and the United States would address the problems of other countries such as China and France continuing their testing?

Dr. **WAGNER**. I think it would not. Both those nations assess their own national security objectives and believe that nuclear testing is important to achieve them, I believe.

The thought that is sometimes expressed that the United States and the Soviet Union by refraining from testing would set an example for those nations and for nations that might be considering a nuclear weapon capability but don't have one today. I think that is a naive thought. I think nations assess their own national security interests and do what is required to achieve them; so I think it would not have that effect.

Mrs. **BYRON**. We have seen several nations that have had peaceful nuclear explosions, India, for instance. What are the real differences between peaceful explosions and those for testing nuclear weapons?

Is there a great difference there?

Dr. **WAGNER**. In the case of India, I doubt that there is little difference between the nuclear explosive tested and a nuclear weapon. It was undoubtedly a primitive explosive, and in such cases, you couldn't tell the difference between a peaceful and a nuclear design.

In the case of the United States and the Soviet Union, 10 and 20 years ago when we were engaged in trying to develop technologies for using PNE's, there were some differences in the explosive designs, between those that were being developed for weapons applications and those for industrial, peaceful applications.

However, I should say that with regard to being able to maintain expertise in weapon design at the laboratories and in the people who do the work, there is no difference between the two. The same physics is involved, many of the same engineering questions are involved, and so developing an explosive for peaceful purposes maintains the same competence needed for developing weapons designs.

Mrs. **BYRON**. General Hoover, could you elaborate a little bit on the weapon systems which we had problems with, that were discovered after the 1958-1961 moritorium was lifted?

I think this was discussed recently in a report issued by the Office of International Security, and I think probably the full explosion of a warhead does give you a much better capability to correct design flaws.

Were there many or a few that were discovered after that moritorium?

Mr. **HOOVER**. I think there has been a sufficient number, whether we want to call it many or a few, a sufficient number to raise the basic concern that without the testing you would have some diminished confidence in your nuclear stockpile.

The particular report which you reference, cites some examples, one in particular, the W47, which was a strategic warhead. It had problems that were discovered as a result of testing that did not require underground tests, but the correction to the problems that were found required ultimately that we do underground tests.

There are several other unclassified examples. There are some classified examples of more recent experience wherein, I believe, if we had not been able to go back and retest the design, then we would have had a lower confidence in that particular weapon.

Mrs. BYRON. Wouldn't, though, a comprehensive test ban probably actually increase the size of our arsenals and also the Soviet arsenal in the long run, because we would be dealing with a degree of uncertainty?

Mr. HOOVER. I think that is a logical—that would be a logical outcome. If you had less confidence, you would therefore, in terms of wanting to raise your probability of success, you would have to commit more warheads than you would if you knew more precisely what the reliabilities of the warheads were.

You might also make your designs much more conservative in terms of the amount of nuclear material. You could overdesign the warhead, if you will, in terms of adding extra nuclear material so that you were more certain that it would perform over a wider range of uncertainty.

So, yes, to your question, we think it would exacerbate the arms race rather than necessarily limit it.

Mrs. BYRON. We have read several places that the Soviets have probably exceeded the 150-kiloton limit in the threshold test ban on several occasions; however, the evidence is very ambiguous.

If that is the case, why are the allegations made?

Is there fairly concrete evidence that we have seen that they have exceeded the limit?

Mr. HOOVER. As you indicated, there is some ambiguity in the data. I think that there is enough circumstantial evidence that would indicate that certainly within reasonable doubt that they have had some tests that have exceeded the test ban limit, but it is very difficult to prove in a court of law in absolute terms.

Mrs. BYRON. But you are feeling fairly confident that is the case?

Mr. HOOVER. Yes.

### USE OF SEISMIC TECHNIQUES FOR VERIFICATION

Mr. WAGNER. If I could add to that. I think that situation really illustrates why the current seismic techniques are not particularly useful for verification. The situation we find ourselves in is, since 1976, when the Threshold Test Ban Treaty went into effect, six or eight events, seismic events, in the Soviet Union, which appear to be above the threshold, but there is such uncertainty in the correlation between the seismic shaking and the yield, that it has to be a kind of a statistical estimate.

You have to say there is a 60-percent or a 40-percent possibility. When you take all of those together I think we can make a rather confident statement that at least one of them has been above the threshold, but we can't point to which one; and I think that puts a difficult flavor on seismic verification.

It is as if in verifying compliance with the ABM Treaty, we had to say there are a half-dozen large radars in the Soviet Union and one of them is an ABM radar, but we are not sure which one, rather than being able to say that at Krasnoyarsk, they have built an ABM radar.

I think that would be an unacceptable situation for that kind of verification, and I think that it has unacceptable elements, too, for the test ban verification.

Mrs. **Byron**. Mrs. Holt.

Mrs. **Holt**. Thank you, Madam Chairman.

To me, verification has always been the bottom line on this thing. We can negotiate and negotiate and try our best to convince the Soviets that we should work together on this, but we have never made any headway on verification.

I don't think it would ever be possible to develop a system of detection that would overcome their ability—I mean they could always distort our ability to analyze their cavity decoupling; they could always do something a little bit more to change it. As you said it would be expensive, but that never seems to deter them.

Wouldn't they always stay one step ahead of us in that area?

Dr. **Alewine**. I believe it is probably true that we can design a network to come up with a certain level of detection within the Soviet Union. However, for signals at a very low level of detection, such as these signals from a cavity decoupled, one kiloton nuclear explosion, you find that you are overwhelmed by the large numbers of natural events that must be sorted out. There are many thousands of events that occur annually in the Soviet Union, so you must look for the one signal from an explosion in these thousands of natural events. For each signal that is detected you have to make a decision; is this from a natural event, or is this from a nuclear explosion.

Mrs. **Holt**. Even if we got to the point where we could tell it was a natural event or an explosion, if they saw we could do that, couldn't they build a mountain or anything, a cavern, or create a river, which they seem to be able to do and overcome our ability to properly analyze?

Dr. **Alewine**. There are other evasion techniques besides decoupling that can be used to hide the fact that you conducted a nuclear test. You could disguise it under a large chemical test, thus distorting seismic signals that go out.

Mrs. **Holt**. It seems to me, no matter what we do in a closed society, where we cannot trust the data that we get, even if we had the capability to develop high quality stations, as you say, and arrays within the Soviet Union, so long as they control the data that is coming out of that we can't verify; and this concerns me more than anything we are talking about.

Do you feel that we are moving as rapidly as we can in our research in verification methods?

I know we are stepping up our efforts to improve it; but are we going as fast as we could?

Dr. **Alewine**. I suppose one could say that we could go faster, but we do have a very vigorous program. I don't know of any avenue that appears to have any promise, that we are not pursuing.

Mrs. **Holt**. Do you feel, really, honestly that we can ever verify so long as we are dealing with a closed society?

Dr. **Alewine**. Our potential monitoring capability. Well, it depends on the yield level which is banned.

Mrs. **Holt**. Accurately enough—the level, you can either do it, or you can't do it.

Dr. **Alewine**. If you are asking whether or not we can verify a zero yield treaty, then I must answer that there is no way from seismological means, or any means that I can now imagine, that we could ever verify such a treaty with 100 percent confidence.

Mrs. **Holt**. Thank you very much.

Mrs. **Byron**. Mr. Ray.

Mr. **Ray**. Thank you, Madam Chairman.

Dr. Alewine, thank you for you testimony and all the testimony this morning.

I understand that if the Soviets would provide us with certain calibrating data we could determine more about whether the underground test was a low yield or a high yield.

Am I correct in assuming they could provide that data to us?

Dr. **Alewine**. Yes, sir.

Mr. **Ray**. Let me also ask, and I may be mistaken on this, but I thought I remembered that in SALT I there was a provision which allowed on-site verification for underground testing by all parties.

Am I incorrect in that?

Dr. **Alewine**. I am not familiar with that.

Mr. **Ray**. There never has been any occasion that the Soviets would allow verification in the past?

### THE SOVIETS AND VERIFICATION

Mr. **Alewine**. In the Peaceful Nuclear Explosion Treaty [PNET] that there are provisions under which, if certain circumstances were met, U.S. technicians to come into the Soviet Union to examine a site where they planned to conduct a peaceful nuclear explosion and to make certain measurements. The conditions for triggering such a circumstance were always under the control of a party carrying out such a treaty, and probably this would never happen. Most of the provisions apply only happen if the aggregate yields of the peaceful explosions are planned to exceed the 150 kiloton limit.

I would like to make another comment on your statement about exchanging the yields. As part of the Threshold Test Ban Treaty that was negotiated in 1974, we were supposed to exchange with the USSR calibration yields. This was to include two calibrations for each area of our test sites that are considered geophysically homogeneous. If this data could be believed, it could be useful to us.

However, we have no independent way to verify whether or not the data they were giving us is accurate. So we have to look at this with some skepticism. In the course of the Threshold Test Ban Treaty, since 1976 we have complained about the yield sizes of a number of their tests. When the yield estimates get above a certain threshold, we have issued complaints to the Soviets about them, so they know the ones for which we have concerns.

Under the current TTBT data exchange arrangements, it would be an easy matter for the Soviets to provide us with calibration yields that support their allegations that they have not cheated. Unfortunately, we would not be able to tell otherwise. So unless there is some way that we can independently verify the data to be exchanged, this information is not really going to be very useful to us.

Mr. **Ray**. Is that something that would be raised in round one and two, or constantly keep it before the——

Dr. **Alewine**. We have raised the issue on a number of occasions with the Soviets, that we have these technical problems about verifying the treaty. We have offered to sit down and talk to the Soviets about this and to explain the case on technical grounds. However, the Soviets have not accepted the invitation nor have they accepted the President's invitation to come to the Nevada test site to see how we make yield measurements.

Mr. **Ray**. They refused that and didn't make any counter offer to us?

Dr. **Alewine**. That is correct.

Mr. **Ray**. Mr. Gorbachev was beating us about the head during the time that we were testing the Asat, and I believe we had a SDI component test also this week, as I understand. It just seems to me that they have got a lot better strategy.

They beat us and attacked us, yet, I don't see us coming back on such things as the calibration and making that as public, or maybe it is just not getting the attention that it deserves.

Do we need, anyone of you, a better strategy, a more aggressive strategy to get the word out on our offers?

The President last night said we had proposed to reduce warheads in six different ways, yet there was no comment from the Soviets. That is the first I had heard of that.

It appears to me we ought to let the world know that we are interested, we are doing some things ourselves, and the ordinary individual is not picking up anything but just mealy-mouthed silence, in many cases, on our part.

Dr. **Wagner**. Could I comment on that?

Mr. **Ray**. Yes, sir.

Dr. **Wagner**. And using again the example of seismic verification to illustrate the point, it is a complicated technical issue, which I believe makes it not particularly useful as a verification tool, but in trying to explain the complications and explain why we believe we need these additional measures that the President has proposed, we have to be absolutely accurate, particularly, since scientists, not in the government in this country, are perfectly at liberty to criticize our statements.

That situation does not pertain in the Soviet Union, and I think there is always going to be that inherent symmetry between the way they use the media and the way we have to deal with the media.

Mr. **Ray**. That is a good point. Thank you.

Mrs. **Byron**. Mr. Badham.

Mr. **Badham**. Thank you, Madam Chairman.

As I understand it we, or a group in the business of producing nuclear warheads, have to test for reliability and usability, and you have to test for design purposes; is that correct?

Dr. **Wagner**. That is correct.

Mr. **Badham**. Do you for design and reliability, shelf life, and all of that, have to test to full size item; or could you test a piece of it or a prototype, or what?

Dr. **Wagner**. There are a number of tests that will increase your confidence, but I think the true proof of the pudding is when you can test it at its design yield.

Mr. **Badham**. Doesn't that run into some difficulty with the threshold then?

Dr. **Wagner**. It does for those warheads which exceed the threshold, obviously. Fortunately, for those warheads that are in our arsenal today, which if tested would exceed the threshold, we believe we have an adequate history of testing prior to the Threshold Test Ban Treaty. Moreover, we can test, for example, the primary or a combination of the primary and an altered secondary, which would not exceed the threshold.

The primary design is the sort of bellweather of whether it will work, and so, we can test all primary designs which are at a lower yield thereby giving us continued reasonable assurance that the weapon will work at its full yield.

Mr. **Badham**. In our national policy to pursue arms reduction, disarmament and the like, we more or less have to pursue or go down the path of testing, test reduction, test, and so forth, which of its very nature requires verification, and according to what I understood you gentlemen all say this morning, that the need for verification is not going to change, at least in the foreseeable future; is that correct?

Dr. **Wagner**. I believe that is right.

Mr. **Badham**. Would you, therefore, then agree or disagree with the comment then that really when you are talking about verification it has to be knowing, willing and voluntary?

Dr. **Wagner**. I think that onsite inspections, or at least in-country techniques which one can require or, which are mandatory are going to be a necessary part of any verifiable test ban.

Mr. **Badham**. I mean willing, voluntarily, and all of that, because in a country the size of the United States or particularly the Soviet Union, you could have all the onsite inspectors you wanted over at point A, and they could do one at point B, and nobody would ever hear about it in their society; is that correct?

Dr. **Wagner**. It would have to be extensive, a lot of coverage, and the inspectors would have to be at liberty to go to point B, if they felt that was necessary, so provisions has to be mandatory.

Mr. **Badham**. Having agreed on that, basically, the express policy and the psychology and the psychiatry of the Soviet leadership, or the great Russians, or whatever, is that they don't allow people to do that throughout history ever, right?

Dr. **Wagner**. That is true.

Mr. **Badham**. So are we kind of blowing smoke, or pursing a path for, perhaps, PR purposes, saying that, yes, we ought to have one but it has to be verifiable, knowing that the chances of that in the real world are nil?

Dr. **Wagner**. Their desire not to have people moving freely within the Soviet Union is so ingrained, I believe, that——

Mr. **Badham**. That is not Communist, that is Russian.

Dr. **Wagner**. I think it is an ingrained characteristic. It sometimes leads me to think that if we could ever get the degree of in-country verification technique that would be necessary we almost wouldn't need it because it would have meant such a fundamental change in their outlook that many other things would fall into place that we would like to make happen as well.

Mr. **Badham**. But we as a part of our dedication to arms reduction and cooperation, we have to keep on pursuing those, it is virtually an unattainable goal.

I want to thank all you gentlemen for your testimony.

Mrs. **Byron**. Once again I want to thank the three of you and Secretary Perle, because, as I said earlier, the only way we can be informed is to listen to the experts; and I appreciate the testimony this morning.

We look forward to this afternoon with another group. I think we have a vote on the floor.

It seems like a proper time to adjourn until 2 o'clock.

Thank you very much.

[Whereupon, at 11:55 a.m., the hearing recessed, to resume at 2 p.m., the same day.]

## AFTERNOON SESSION

Mrs. **Byron**. The panel will come to order, please.

Our first witness this afternoon is Dr. Roger Batzel, who is Director of the Lawrence Livermore National Laboratory. Dr. Batzel will be followed by Dr. Paul Robinson, who is the Principal Associate Director for National Security Programs at the Los Alamos National Laboratory.

Dr. Batzel and Dr. Robinson will be representing two of the three national weapons laboratories. Dr. George Dacey, president of the Sandia National Laboratories, will be appearing on Friday morning.

The national laboratories are responsible for designing, testing and maintaining the technical expertise necessary to assure that the nuclear weapons arsenal remains an effective deterrent. The three national laboratories also provide the expertise and technology necessary to verify several arms control treaties. In addition, the national laboratories conduct research, experiments, and tests to determine whether new developments in technology can logically be applied to weapons by other countries such as the Soviet Union.

It has been said that the United States would be better off with a comprehensive test ban than without such a treaty. The term "comprehensive" is seldom defined by the proponents of such agreements, nor have there been precise definitions of what constitutes "testing."

Most proponents of test bans do not envision total nuclear disarmament by the nuclear weapons states and readily admit that some degree of testing would be necessary to maintain a viable nuclear deterrent. Some proponents argue that efficient testing can be done without resorting to exploding nuclear devices. Others ask: What is the point in not testing if the several nuclear arsenals in the world can, in fact, be maintained and improved without testing?

The panel hopes that the witnesses today and on Friday can provide answers to the frequently asked questions:

Why is nuclear testing necessary?

What are the military implications of testing?

Does testing cause nuclear weapons proliferation?

Can a test ban be evaded?

And, in view of the spread of nuclear technology, can proliferation of nuclear weapons occur if there is no testing?

At the conclusion of the questions put to Dr. Batzel and Dr. Robinson, Mr. Robert I. Rubinstein, Director of the Weapons Intelligence Division of the Department of Energy, will present a classified briefing on Soviet testing and production of special nuclear materials.

Welcome to the panel, gentlemen. Mr. Batzel, you may begin.

I am going to ask you if you will give us 5 minutes because we have a vote on the floor and I think it would be better for us to go vote and then come right back.

Thank you very much.

## STATEMENT OF DR. ROGER BATZEL, DIRECTOR, LAWRENCE LIVERMORE NATIONAL LABORATORY

Dr. BATZEL. Madam Chairman and members of the panel, I welcome the opportunity to discuss the issue of limitations on nuclear testing and what this means in terms of nuclear design, stockpile reliability, and I really will not discuss verification today.

Fundamentally, as long as our national security depends on the deterrence provided by nuclear weapons, I am convinced that continued testing is necessary to retain and maintain that deterrence capability and I believe that a comprehensive test ban treaty is not in our national interest.

I am responsible as director of the Lawrence Livermore National Laboratory for certifying that the weapons designed by the laboratory will function when and if they are ever needed.

Nuclear testing is fundamental to ensure the feasibility and reliability of these weapons. In the first place, nuclear weapons are complex mechanisms and they are made of highly reactive materials. Changes do occur during the stockpile life. These metals and salts interact in unpredictable ways. We discover these interactions by means of regular stockpile surveillance performed by highly-trained technical people—people who have been part of the design and part of the continuing experimental program associated with nuclear weapons development.

And it is clear that under a comprehensive test ban treaty the laboratories would lose their skill and expertise. We have dedicated people at the laboratories, and the reason they are there, much of the reason they are there, has to do with the fact that nuclear weapons technology is important to the country. And if a test ban were to be in place, the opportunity for experimentation would be removed from those people. They would also view such an action as a lowering of the importance of that particular technology. The consequence would be that the skilled people would leave the laboratories.

I don't believe that situation is symmetric as far as the Soviet Union is concerned. There is no reason to believe that the Soviets won't instruct their people to stay within their weapons laboratories and continue to work those problems. It would be virtually impossible to replace with talented people the people we have in the laboratory if we were to have a comprehensive test ban treaty.

We maintain our confidence in weapon reliability in four ways: First, stockpile surveillance: Second, quality assurance; third, testing of nonnuclear components; and fourth, actual full-scale tests of the nuclear explosive.

Nonnuclear tests are not sufficient. We are reminded every once in a while that that is the situation by finding that, according to the best we can do with nonnuclear tests, we cannot understand the actual nuclear test results, which are sometimes much differenct than we had predicted.

### MONITORING PERFORMANCE OF THE NUCLEAR STOCKPILE

Another issue is that we cannot statistically monitor the nuclear performance of the stockpile. What this means is that the nuclear tests we do conduct are all the more important. We, however, do production verification nuclear-proof tests. We randomly pull weapons from the stockpile and verify their continued performance. These tests have identified real problems with the stockpile and many of these issues cannot be resolved without a nuclear test.

There is always the issue raised of just remanufacturing the old weapons. That may be possible in some situations. However, the kinds of problems one usually runs into are those which mean that you have to correct a problem in the stockpile after a few years, and what you don't want to do is build that same problem back into the stockpile. So the only real alternative one has is to make a modification to correct a fault and what that means is that one must indeed verify those changes with a nuclear test.

We do not have a first principle, a binitio understanding of how nuclear weapons work. We are conducting and continue to conduct experiments which relate to establishing a better base of understanding of nuclear weapons, but we are not there yet and we won't be, at least in my view, for the immediate foreseeable future.

Even our most experienced designers are surprised every once in a while by the effect of minor "changes" to our nuclear weapons. These are changes which are dictated by security or safety or a wish to meet a very strict military requirement. And our nuclear weapons have been designed under the assumption that testing of those weapons will be permitted. We have pushed, as was indicated by Dr. Wagner earlier, the nuclear weapons technology to maximize the effectiveness of our strategic systems.

[The following statement was supplied for the record to further clarify the above testimony:]

> While these weapons were designed under the assumption that nuclear testing would continue, so that if any problem ever arose in the stockpile, a nuclear test could be performed to help certify that the weapon would continue to work as it was designed to, they were designed to be as conservative as possible within the constraints of meeting the military requirements to hedge against the possibility of a comprehensive test ban treaty (CTBT).

What that means is that we have pushed our nuclear weapons technology, but that says we don't have much margin for error. It is clear that a comprehensive test ban treaty would involve the loss of expertise at the laboratories and in the longer term would de-

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crease our confidence in our nuclear weapons stockpile and deterrent capability.

Now, when we try to transfer that image to the Soviet Union, we can't quite do that. Their systems, at least as best we can tell, have fewer constraints on size and weight of the nuclear weapon and so at least in a qualitative way one would judge that their testing constraints are not so severe.

It is clear that the Soviets over the last 15 years have undertaken an extensive stockpile modernization. Regarding their new systems—new strategic systems that are coming along—clearly the warheads for these have been tested. Our stockpile has decreased in both numbers and yield since the peak in the sixties and that has been a result of modernization efforts within our nuclear weapons program.

Another major problem posed by a CTB is that it would prevent exploration of new concepts and new ideas. To some of the opponents, that is a good thing, but it should be noted that the new capabilities are likely to be defensive in nature and not offensive and would lead to less destructive weapons overall.

A CTB would certainly preclude the kinds of programs we are conducting in conjunction with the President's strategic defense initiative. An example of that is the nuclear driven x-ray laser.

So that overall from my point of view, I come back to the conclusion that continued testing is necessary to retain and maintain our deterrent capability, because continued testing is necessary to retain and maintain our deterrent capability.

Thank you.

Mrs. BYRON. Thank you.

I think we will have the testimony from Dr. Robinson and do the questions at the same time if that is all right.

Does anybody have a plane to catch?

## PREPARED STATEMENT OF DR. ROGER E. BATZEL

### VIEWS ON A COMPREHENSIVE TEST BAN

I will address the following major issues regarding a CTBT: 1) the impacts of a CTBT on our national security, 2) stockpile confidence, 3) current verification capabilities, 4) possible means for evasion of a CTBT, 5) detection and identification of cavity-decoupled explosions, 6) the potential promise of high-frequency seismic signal detection, 7) the role of on-site inspections, (8) what our Laboratory is doing to prepare for a CTBT, (9) the disadvantage of a test moratorium, and, (10) impact of a CTB on nuclear proliferation.

### 1. The Impacts of a CTBT on our National Security

As long as our national security interests depend on the deterrence of war with nuclear forces, I believe that continued testing is necessary to maintain this deterrence capability and that a CTBT is not in our national interest. Our deterrent depends on nuclear testing and the Soviets know this.

I have the responsibility to certify that weapons that have been designed at my Laboratory will function when and if they are ever needed. These weapons were designed under the assumption that nuclear testing would continue, so that if any problem ever arose in the stockpile, a nuclear test could be performed to help certify that the weapon would continue to work as it was designed to.

[The following statement was supplied for the record to further clarify the above testimony submitted for the record:

> While these weapons were designed under the assumption that nuclear testing would continue, so that if any problem ever arose in the stockpile, a nuclear test could be performed to help certify that the weapon would continue to work as it was designed to, they were designed to be as conservative as possible within the constraints of meeting the military requirements to hedge against the possibility of a comprehensive test ban treaty (CTBT).]

Under strict guidelines from the government, our scientists designed those weapons to minimize overall weapon system costs and to maximize military effectivness, as well as being concerned with stockpile life. The designs would have been very different if the guidelines from the government had placed primary emphasis on stockpile longevity. This, in turn, would have led to very different military systems - missiles or other platforms with different throw-weight, range, and accuracy.

Many important reasons against a CTB have been advanced during past debates and they are just as valid today. These reasons are not concerned with individual weapon systems but deal with the supporting base of our weapon technology. Nuclear weapons are complex mechanisms, and of necessity, are made of highly chemically reactive materials. Because of these inherent characteristics, it has been found over the years that changes have occurred in stockpile weapons which brought to question whether a weapon would perform as designed. Today we have procedures which can identify and correct these faults as they occur. These procedures rely on skilled personnel and on some occasions the need to carry out a nuclear test. Under a CTB, we would lose our skills and expertise. Weapon design experts would inevitably leave the weapons program because they could not verify their theoretical ideas with experiments. Those who stayed would gradually lose their sharpness. New workers would never have the opportunity to gain experience. I have no doubt that a CTB would lead to the loss of expertise and in turn to the loss in the reliability and confidence in our nuclear weapon systems and deterrent capability. Whether these considerations would apply to the Soviets, I do not know. There are arguments on both sides of the issue. But either way, taking a path which could lead to grave doubts about the reliability of our deterrent appears to me a prescription for political instability, and possibly, disaster.

A CTBT attempts to provide an improper technical fix to a problem for which there is no technical solution. I sincerely hope that some day we and the Soviets will be able to live together in harmony. Until then, we must continue to rely on deterrence as we have for the last forty years. I believe that the ultimate solution to our problems will not be technological but rather political. Deterrence must continue to work until that time, and technology can play a role in guaranteeing the continued reliability of our ability to deter. The ability to test nuclear weapons is a crucial aspect of that technology. For these reasons, a CTBT appears to me to be a symbolic, ineffective, and potentially dangerous kind of arms control.

For the last 15 years the Soviets have undertaken an extensive modernization program, while our nuclear deterrent force has aged. Our forces are in need of modernization for improvements in safety, security, survivability, and effectiveness. A CTBT would prevent these needed improvements and would lock in asymmetries that have developed between us and the Soviets. It would severely impact the development of new weapon systems vital to our national security. These include nuclear directed energy weapons such as the x-ray laser which have promise for application to the President's Strategic Defense Initiative.

A CTBT is, furthermore, an incomplete form of arms control. It would limit only one part of the equation. It drastically inhibits development of the nuclear weapon itself, while there is progress in other aspects of Soviet weapon systems, such as increased accuracy of missiles, expansion of ABM capabilities, further improvements in air defenses, and potential improvements in antisubmarine capability. The last two developments affect what are generally acknowledged to be our most stabilizing weapons systems, because they are a second strike capability.

A CTBT should be considered only in the total context of U.S. arms control objectives. For example, our START proposal allows for the modernization needed to achieve a more survivable deterrent, while at the same time calling for substantial force reductions. It would be most unwise to enter into CTBT negotiations until we see what can be accomplished in all aspects of the current Geneva talks. These negotiations could produce agreements that would start us in the direction of a much more stable force structure, at reduced levels, on both sides. The talks could produce a significant step towards enhancing world stability, something which I believe is an essential ingredient to the political solution I have just described. However, I believe that this would only be the first step of many toward that political solution.

In regard to weapon reductions, it is important to note that an untested stockpile would not eliminate or reduce nuclear weapons. Instead, it could lead to increased numbers of weapons to make up for uncertainties in performance.

## 2. Stockpile Confidence

The maintenance of confidence in the reliability of our weapon stockpile consists of the stockpile surveillance program, the quality assurance and reliability testing of non-nuclear components, and the nuclear testing of warhead components or related nuclear devices in the on-going nuclear weapon development program. While non-nuclear quality assurance/reliability testing sometimes detects problems with the nuclear component of warheads, the most serious stockpile problems are only revealed and solved by nuclear tests.

We cannot statistically monitor the nuclear performance of the stockpile. This makes the nuclear tests we do perform all the more important. We regularly do production-verification nuclear proof tests and randomly pull units from important systems in the stockpile to verify their continued proper performance. Mainly, we use the continuing nuclear test program to confirm the design choices made in stockpiled weapons. Nuclear tests have identified design problems and unanticipated effects of aging which dramatically affected performance of certain devices, in some instances affecting a large fraction of the stockpile. Major unexpected vulnerabilities were also revealed and safety was found to be reduced.

An example of a stockpile problem that was revealed by a nuclear test involved the W45 warhead. The W45, which was used in the Little John missile and then in the Terrier missile and the atomic demolition munition (ADM), was developed in part during the 1958-1961 test moratorium. When the W45 was tested after the moratorium with certain small changes to simulate the effects of aging in the stockpile, the result was a rude surprise: the test device gave only half its rated yield. Roy Woodruff's testimony to be given tomorrow gives other examples of stockpile problems related to the moratorium. More recent examples of problems that have been revealed by nuclear tests are given in a classified addendum to my testimony.

Many stockpile problems which have been identified, whether by nuclear or non-nuclear tests, have required nuclear tests to guarantee a final design. Alternatives would have involved unacceptable reductions in yield and reliability or unacceptable operational limitations.

With respect to remanufacture, even if it were determined in principle to be the best fix, experience has taught us that it is literally impossible to prevent changes in materials and workmanship quality and standards, or even specifications and working drawings, over an extended period of time. We have no way of knowing the impact of subtle changes in manufacturing practices, without performing a nuclear proof test to gain the confidence that the effects of seemingly harmless process changes were properly addressed. In addition, since we do not have a "first principles" understanding of nuclear weapon physics, we may not be able to control all the correct specifications. Thus it is imperative to test the effects of changes. The examples discussed in the classified addendum illustrate the ways in which testing substitutes for a lack of first principles understanding.

In regard to political instability, we have an open society, and it would be impossible to hide for long any diminished confidence that might develop with the stockpile. We believe that the situation would be quite different for the Soviets who have a closed society. This is just one example of an asymmetry that would exist under a CTBT.

### 3. Current verification capabilities

An LLNL scientist published an article in Science recently[1] which presents a balanced description of our nation's capability to monitor a CTBT. Current published estimates of the Air Force Technical Application Center's (AFTAC) minimum detection capability (90% confidence) are classified, and the classified addendum to my testimony discusses this capability. The Group of Scientific Experts to the Conference on Disarmament has published[2] their estimate of the detection capability

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1. Hannon, W.J., "Seismic Verification of a Comprehensive Test Ban," Science, January 18, 1985.

2. "Report to the Conf. of the Committee on Disarmament of the ad hoc Group of Scientific Experts to Consider International Co-operative Measures to Detect and Identify Seismic Events", Rept. CCD/558. UN Conf. of the Committee on Disarmament, Geneva (8 March 1978).

of a teleseismic network to be magnitude 4.0 throughout the USSR (this magnitude is a quantity very similar to the Richter magnitude used to classify earthquakes). A magnitude of 4.0 corresponds to a yield of about 10 kt for an explosion detonated in dry alluvium, a medium in which the explosive energy is partially decoupled. For well-coupled explosions in hard rock, this magnitude corresponds to a yield of 1 kt.

Detection of an event does not imply identification as to whether the event is an earthquake or an explosion. The number of detected events rises rapidly as the detection capability improves, and their identification becomes more difficult due to low signal-to-noise ratios. Thus, we expect that there may be more than 100 events per year which cannot be identified with our current techniques. This large number of unidentified events could create havoc with our ability to effectively monitor a CTBT. The classified addendum to my testimony gives more detail on this subject.

Effective monitoring of a CTBT to very low levels (approaching 1 kt) will require an in-country seismic network in order to counter the more promising evasion methods. The deployment of in-country seismic stations was extensively discussed at the last round of CTBT negotiations which ended in 1980, and there was considerable progress towards getting the Soviets to agree to the need for a limited number of such stations. (They had agreed to ten stations for a period of three years when negotiations ended, each consisting of a seismometer to measure vertical and horizontal motions. Their agreement was contingent upon both the U.S. and Great Britain also having ten stations on their territories.) In order to gain experience with such networks, LLNL is studying the performance and assessing the quality of data produced by the Regional Seismic Test Network (RSTN) installed in North America by the Department of Energy. A similar but larger network might be deployed in the USSR to monitor compliance with a future CTBT. Such a network will improve the AFTAC detection capability by several tenths of a magnitude unit or more.

## 4. Possible Means for Evasion of a CTBT

The above mentioned Science magazine article discusses a number of ways in which a determined party could attempt to evade a CTBT. Decoupling of a nuclear explosion by detonation in a cavity has long been suggested as a promising evasion method. The cavity effectively absorbs the explosion energy, and reduces the size of the seismic signals. Because of its importance, cavity decoupling is discussed in some detail in sections ~~4~~5-6 below.

A second method with potential for evasion is to detonate the explosion at a time when its signals would be hidden in the signals from an earthquake. The use of in-country seismic stations would severely limit the attractiveness of this evasion scheme by requiring that the explosions be fired in close proximity to an earthquake in space and time. Our Laboratory is currently engaged in a joint research project with the University of California at Berkeley to determine if such an evasion approach can be executed. The requirements for in-country seismic stations that would be needed to detect cavity-decoupled events are discussed below.

The masking and false alarm problems posed by chemical explosions would also be significant under a CTBT. At present, we can only identify as chemical explosions those in which the energy is released in a series of slightly delayed explosions, as opposed to one simultaneous explosion. These sequential explosions produce signals quite uncharacteristic of a nuclear explosion. Note that there is a need for simultaneity in chemical explosions that simulate nuclear blast effects, and such experiments could not be done using delayed explosions. We are currently examining the possibilities for evasion under the guise of chemical explosions, and will propose procedural methods for notifications and inspections, since technical monitoring methods do not appear capable of discriminating between chemical and nuclear explosions.

We have studied the possibilities of CTBT evasion by testing in deep space. We believe that it would be possible for the Soviets to launch a rocket, say under the guise of a deep space probe, that could carry number of nuclear explosives and a diagnostic package. The tests could b carried out behind the sun or at a distance well beyond the detection range of our radiation monitoring satellites. The same diagnostic package could be used for each of the nuclear explosions and the data could be ultimately telemetered back. We estimate the cost for doing such a "series" of explosions to be in the range of $100 million. This is not excessively expensive compared to the current costs of underground testing. Of course, it is cheaper to test underground, and there is probably little incentive to perform such a test today. However, under a CTBT, a determined evader might be tempted to try such an experiment, and he would not be forced to limit the yield of his test to the TTBT limit of 150 kt.

Other evasion scenarios during a CTBT could include testing outside of one's territory, for example in the ocean. Although detection of such a test would probably be straightforward, attribution of the test to a particular party might be extremely difficult.

## 5. Detection and Identification of Cavity-Decoupled Explosions

We estimate that it would require more than 30 high-quality in-country arrays or equivalent single stations in the USSR at sites with high signal-to-noise ratios to detect signals from decoupled explosions, or equivalent size earthquakes, with yields of about 1 kt with a 90% degree of confidence. With 15 such stations, we could detect decoupled explosions with yields in the range of 3-10 kt with 90% confidence. Note that detection of an event does not mean identification as to whether the event is an explosion or an earthquake. With either network, the 90% confidence level for identification may include events that are 2 to 3 times as large as the detection threshold. Note that we are discussing here high-quality arrays or equivalent stations, as opposed to the 10 simple stations that were the subject of negotiation with the Soviets in 1980. The negotiability today of such a complex network is unknown.

Without any seismic stations or arrays inside the Soviet Union, our ability to monitor decoupled events would be strongly diminished. With cavity decoupling, the Soviets could test up to 10 kt with low probability of detection by an external network. However, it is important to note that it would be an extremely difficult engineering feat to construct cavities large enough to decouple explosions much larger than 10 kt. We cannot rule out the possible construction of such cavities, say by solution mining techniques, but such construction would be a difficult engineering challenge and would be quite expensive. Suitable cover operations would be required to hide the construction activity.

## 6. The Potential Promise of High-Frequency Seismic Signal Detection

Recently, "breakthroughs" in seismic detection and identification of nuclear explosions have been reported. In particular, high-frequency measurements are claimed to reduce the difficulty of detecting and identifying decoupled explosions in cavities. These claims follow from preliminary work at my Laboratory and are based upon extrapolation from lower frequencies and larger seismic events than are relevant to monitoring cavity decoupling. Demonstration of the actual capability in realistic monitoring settings are needed before such claims can be used as the basis for a negotiating position. We and others are working on topics pertaining to the new capability.

The key elements are: 1) the possible reduction in the cavity decoupling ratio at high frequencies (10-40 Hz), 2) observations of low noise and large signals at long distances between various source and receiver locations, and 3) the theoretical differences in high-frequency spectra between earthquakes and explosions that may help with the identification problem. Even with the improvements resulting from the postulated developments, improved monitoring would become possible only through the use of many (30 or more) internal stations throughout the Soviet Union. These will have to be high quality, low-noise stations, or arrays consisting of about 25 seismometers per station. A single station prototype of this concept has recently been set up in Norway. It has [redacted] [redacted] 25 seismometers within a 1.5 km radius.

Therefore, the use of high-frequency seismic stations and arrays may provide improved detection and identification capability, but the number and the capabilities of the stations needed appear to be significantly greater than those discussed in the 1978-1980 CTBT negotiations. Much more research is needed before a more definitive statement can be made.

## 7. The Role of On-Site Inspections

In 1976, the Soviets proposed at the United Nations a draft CTBT that provided for voluntary on-site inspections (OSIs). They reaffirmed their willingness to accept voluntary OSIs in the the CTBT negotiations of 1977-1980. At that time, the U.S. concluded that voluntary OSIs could serve as a deterrent to cheating, providing that the rejection of a request for an OSI could be established as a serious matter that differed little from thwarting a guaranteed OSI.

There will always be a number of seismic events detected below some magnitude which will be impossible to identify. Therefore, there will always be the need to learn more about specific events. On-site inspections (OSIs) serve to deter the carrying out of clandestine explosions by increasing the economic cost and reducing the technical gain from such tests over that which was possible without an OSI provision, and by raising the political costs of refusing an OSI request to avoid being proven to have been in noncompliance. An OSI can also serve to prove that an unidentified event was in fact an earthquake. However, it is important to note that OSIs should be viewed politically as a sufficient, but not necessary means, to determine if a violation has occurred. OSIs serve as a confidence building measure. OSIs are not foolproof. They might not confirm an explosion in a situation for which we have other strong or irrefutable evidence that a violation has occurred. This requires drawing a very fine distinction which may be difficult to make in practice.

## 8. Planning for a CTBT

While a CTB is not advisable at this juncture, those of us who shoulder the responsibility of certifying the reliability and effectiveness of our nuclear stockpile would be remiss if we did not formulate the necessary plans to carry out our mission in the event that a CTBT were to become a reality in the future. Our Laboratory is preparing for this eventuality in a number of ways. Even under a CTBT, we will still have responsibilities that will include tasks such as weapons maintenance and modification. Identical rebuilds of older weapons cannot be guaranteed, because the fabrication expertise of some key parts no longer exists and some materials are no longer available and would be difficult to match with new replacements. In the past, even our most experienced weapon designers have been surprised when pressed to make what were thought to be minor changes to stockpile systems. In the future, we can virtually guarantee that similar design changes will arise, as they have in the past, that are dictated by safety considerations, use of new materials, new configurations, or new military requirements. Not all such changes require certification by full-scale nuclear testing, but all rely on data obtained in nuclear tests and, most critically, on the judgment and insight that scientists and engineers acquire on the basis of such data. Under a CTBT, experimental data would no longer be obtained from testing, and the pool of experienced specialists would decline.

There is no completely satisfactory way to solve these problems. They may be alleviated to some extent by such measures as the following:

1. We are currently pursuing as vigorously as possible, within the budget, efforts to improve our understanding of present nuclear designs. We are studying the relevant physics of these designs in nuclear tests and by other means.

2. We are placing ever increasing emphasis on the use of supercomputers and numerical models. We continue to pursue vigorous development of even more advanced computers.

3. Although, we are developing and acquiring experimental facilities that might, to some degree, complement nuclear tests, we have yet to develop, let alone visualize, a facility which is capable of replacing nuclear tests. It is extremely difficult to simulate the extreme conditions that exist within an exploding nuclear weapon: velocities of a million miles per hour, temperatures of ten million degrees, and time scales of a few billionths of a second. However, some facilities such as the large lasers at LLNL could provide laboratory data relevant to the interpretation of past tests and would help experimenters maintain some level of relevant skills. Our hydrodynamic experiment facilities at Site 300, located just east of the Laboratory, are being improved to provide new insights into the hydrodynamic behavior of the fission primaries which are used to trigger thermonuclear weapons. At this time, however, there is no substitute for actual nuclear tests.

## 9. The Disadvantages of a Test Moratorium

The Soviets announced a five-month unilateral moratorium on nuclear testing that began on August 6, 1985. A moratorium is a first step towards CTB which I have already indicated is not in our national security interests. Even if a CTB were in our interests, a moratorium would create a negotiating atmosphere which would surrender the incentives that are needed to deal effectively with the Soviets, in particular those that have to do with developing an effective verification regime.

I know of no better argument against a moratorium that that advanced by President John F. Kennedy in a radio and television address to the American people on March 2, 1962:

> "... We know now enough about broken negotiations, secret preparations, and the advantages gained from a long test series never to offer again an uninspected moratorium. Some urge us to try it again keeping our preparations to test in a constant state of readiness. But in actual practice, particularly in a society of free choice, we cannot keep top flight scientists concentrating on the preparation of an experiment which may or may not take place on an uncertain date in the future, nor can large technical laboratories be kept fully alert on a standby basis waiting for some other nation to break an agreement. This is not merely difficult or inconvenient. We have explored this alternative thoroughly and found it impossible of execution."

## 10. Impact of a CTB on Nuclear Proliferation

Proponents of a CTB argue that such a treaty would create an atmosphere conducive to non-proliferation of nuclear weapons. On the contrary, we have no guarantee that those nations most apt to feel the need for a nuclear weapon capability would even sign a CTB.

A CTB might even encourage proliferation under certain conditions, an effect opposite to the view held by CTB proponents. If our stockpile becomes unreliable under a CTB and we cannot meet our commitments to our allies, they may find it necessary to develop their own nuclear capability.

CTB proponents also point to Article VI of the Non-Proliferation Treaty which commits the Parties to the treaty to "... pursue negotiations in good faith on effective measures relating to the cessation of the arms race at an early date and to nuclear disarmament ...". They interpret this statement to mean pursuit of a CTBT. However, it is important to point out that the negotiations that we are currently involved in in Geneva have the same goal as that embodied in these words from Article VI.

CTB supporters also claim that nuclear testing is absolutely essential to the development of nuclear weapons. However, potential proliferators could indeed develop a first generation of simple weapons without testing, although these weapons would certainly be massive and much less sophisticated than could be achieved with testing. It is commonly believed that Israel, for example, has developed a nuclear capability without testing.

## 11. Concluding Remarks

A major problem posed by a CTBT is that it would prevent the exploration of new capabilites and new effects. Of course to many proponents, that feature is not a problem but a major advantage. It should be noted, however, that the new capabilities are likely to be defensive in nature or to lead to more discriminating offensive weapons. (The destruction of cities requires no further R&D.) I believe that the ignorance of such possibilities is very undesirable.

Dr. Michael M. May, Director of LLNL from 1965 to 1971, has written an article entitled "On the Role of the Weapons Laboratories" which has been published in the Bulletin of the Atomic Scientists in June, 1985. This article expresses the importance of maintaining a viable nuclear stockpile and the importance of nuclear testing in meeting that goal. I commend Dr. May's article to you and I have attached it to my testimony for your perusal.

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# A view from the weapons labs

*Continuing a discussion of the role of weapons-laboratories, Michael May counters Hugh DeWitt's contention (Bulletin, November 1984) that the laboratories are a driving force behind the nuclear arms race.*

*by Michael M. May*

TO UNDERSTAND and appraise the role of the nuclear weapons laboratories we must examine the historical and policy context in which they operate. Within this context, it is clear that the U.S. and Soviet governments have recognized that nuclear war would yield either side nothing but overwhelming destruction. Yet, under the world political system that both have inherited, such a war remains a possibility. No one can be sure that the crises and conflicts that might generate it can all be foreseen and averted.

In response, the two countries have evolved somewhat similar pragmatic approaches to the problem of avoiding nuclear war and the circumstances that might lead to it. These approaches consist, in the main, of maintaining invulnerable nuclear forces sufficient to deny the possibility of meaningful victory to the attacker under any circumstances, while acting cautiously where the opponent's vital interests are perceived to be.[1]

Both sides have been firm in demarcating and defending these areas of vital interest: at times, wisely; at times, as in Eastern Europe, with tragic consequences. Both sides have learned to recognize these areas. Yet it is in the very process of demarcating these areas that we have come closest to war; and it is in the process of limiting their (very different) geographical and ideological expansionism that the two sides have exercised the most caution.

As pursued by the two nations rather than as advocated by some of its supporters, arms control has been a part of the cautious approach to matters involving vital interests adopted by the United States and the Soviet Union. The weapons systems banned or limited, and the areas of deployment denied, have been those which, in the view of both governments, contributed little to additional deterrence, but which had the potential for worsening the relationship and for taking money needed for other uses.

The purpose of arms control, apart from propaganda, is to avoid mistakes, political as well as military, rather than to change the basic relationship of cautious, armed deterrence. Avoiding mistakes is perhaps the single most important precondition to avoiding a war that nobody wants, so arms control is a necessary ingredient of such a policy.

The policy described has the advantage of recognizing nuclear weapons and international relationships for what they are, but it is not ethically or intellectually satisfying to many people. For one thing, it does not by itself improve the international system under which we all live, a system which has historically been dangerously unreliable. For another, it does little to assuage the feelings of those to whom nuclear weapons have become symbols of what they deem wrong with our civilization – symbols of human talents dangerously misused and corrupted.

I SHARE THE FIRST objection and have attempted elsewhere to make some preliminary suggestions about it.[2] The second objection lies, I believe, at the root of disagreements about the proper role of scientists, and specifically of weapons laboratory scientists.

Nuclear weapons are both symbols and pieces of hardware. Their role as symbols is what matters to most people, including scientists, most of the time. Nuclear weapons symbolize different things to different people. To some, as we have noted, they symbolize misspent talents and dangerously obsolete institutions. Others, including myself, have a less apocalyptic view of the modern world. But no one's view of nuclear weapons is free of misgivings.

To most people in the U.S. and Soviet defense establishments, and probably to most U.S. and Soviet citizens, the weapons symbolize an ultimate recourse, one that everyone hopes will never be used, but which the governments see, rightly or wrongly, as necessary to discharge the very responsibilities which their citizens lay upon them. At the same time, they symbolize, to many of the same people, a dangerous and irrational arms race.

Weapons laboratory scientists share to various degrees these and other perceptions of nuclear weapons and support a variety of policy initiatives. In addition, however, they are faced with nuclear weapons as pieces of hardware to an extent very few others are.

From the hardware point of view, the laboratories' nuclear warhead designs must contribute to or make possible the survivability of strategic systems. This requirement has led and continues to lead to changes in order to develop new and less vulnerable missiles as well as to improve the operability, safety, and other factors of the systems. Old missiles and warheads are retired as new ones are deployed. Much of the improvement in strategic survivability has hinged on new warhead designs from the laboratories. Similar requirements come from tactical deployments. Compatibility with survivable deployments, operability, better safety and security, and so on provide the objectives for the laboratories' work.

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*Michael M. May is associate director at large of the Lawrence Livermore National Laboratory in Livermore, California.*

David Johnson, United States

Weapons hardware suffers from the same difficulties as other hardware. The materials used are chemically and radiologically active. The components degrade. Sometimes they can be replaced without nuclear tests, sometimes not. Sometimes the effects of stockpile aging are sudden and surprising. With or without testing, much laboratory work goes to maintaining the stockpile.

The laboratories devote much effort to finding out whether nuclear explosives can be put to significantly different military uses. Strategic defensive uses are a recent case in point. The laboratories also investigate new or overlooked nuclear effects. Nuclear winter, which was of course discovered elsewhere, as well as new radiobiological efficiencies for neutrons, are recent examples of such effects, while radioactive rainout is an earlier example.

Finally, the laboratories maintain continuing investigations of the underlying technologies necessary to design and evaluate nuclear weapons. As do most applied sciences, nuclear weapons design generates the need to understand aspects of physics, chemistry, and engineering that have not been previously investigated.

THE LABORATORIES carry out nuclear testing programs for all the reasons that scientists might expect: to verify the adequacy of changes in design, to investigate new concepts, to measure fundamental physical quantities, and, cooperation with the Defense Nuclear Agency, to measure nuclear effects. Again, the special conditions under which nuclear test measurements are made cause the laboratories to develop new instrumentation and measurement techniques. These hardware-related activities are what Congress, the executive branch, and most citizens expect the laboratories to do. They do not fit neatly into any one symbolic or strategic role.

Thus, the changes [illegible] nuclear weapons and the nuclear tests that made submarine-launched nuclear missiles possible extended the arms race, but made deterrent forces far more survivable against attack. The changes and tests that made MIRVs possible made first strikes against fixed ICBMs more effective, but they also made ABM systems less effective and helped pave the way for the ABM Treaty of 1972. The changes and the nuclear tests that might make strategic defenses possible could be used to help deterrence, but they could also be used to help an aggressor. A tested, reliable stockpile can serve both deterrer and first-striker.

Because U.S. weapons laboratory personnel are not government employees, present and former laboratory personnel can be found on various sides of the debates over defense and arms control policies, a situation which is not replicated in any other country, Western or Eastern. Nuclear weapons laboratory employees have stated that there was no evidence that the Soviet Union was cheating on the threshold nuclear test ban;[3] have supported the comprehensive nuclear test ban;[4] have opposed systems in the course of deployment;[5] and have, of course, also taken positions more favorable to defense efforts. Valuable as this ability to participate in the public debate is, it does not relieve laboratory scientists of the responsibility to make the conclusions that must be drawn from the hardware aspects of nuclear weapons as plain as possible.

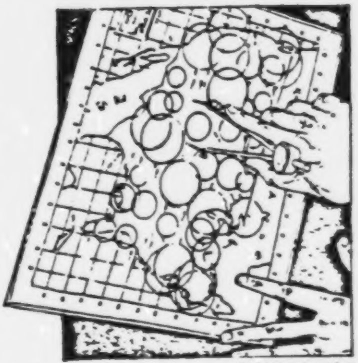
From the hardware point of view, more nuclear tests are needed rather than fewer. The number and kinds of tests permitted result from a political compromise which may be wise or unwise, but which in any case has hardware-related costs, as Herbert F. York, a former laboratory director who is a strong advocate of the comprehensive nuclear test ban and of nuclear disarmament, has stated.[6] These costs must be pointed out even to audiences which are predisposed politically to favor test bans. Also from the hardware point of view, it is the laboratories' job to propose new alternatives for discharging military missions. This is sometimes welcomed by the military services, sometimes opposed by them. It may be said of this activity that the laboratories are driving the "qualitative arms race."

But what is this qualitative arms race? If it is a process of replacing older systems by new ones which will do a better job of strategic deterrence, or of tactical deterrence in Europe, or of strategic defense – assuming this to be a desirable addition to our posture – then we accepted that process when we decided to accept armed deterrence in the first place. We can hope to cut numbers of weapon systems to a minimum and avoid deployments that will not add to deterrence or defense, but we cannot hope to avoid technical change, nor can we expect that the laboratories will not play a role in this change.

MANY MISGIVINGS about the laboratories' role in the defense establishment stem from a belief that, while deterrence may be necessary, the United States and the Soviet Union have far too much in the way of nuclear weaponry for the needs of that task. The excess, it is thought, detracts from both countries' security.

The present dimensions of the nuclear deterrent were established at times when the two sides were repeatedly and dangerously testing each other in areas such as Berlin, Cuba, the Middle East: areas where the two sides considered that they had major interests. Thus, it became important to deter both conventional and nuclear options for changing the status quo by force in these areas.

In the estimate of most people who have participated in this aspect of government on both sides, the need is to avoid war of any kind, as well as crises serious enough to make war a plausible alternative, and not just to deter nuclear attacks on homelands.[7] Once crises or conventional wars become so severe that either side has reason to think the other might strike it, much of the stability of deterrence is lost.



David Johnson, United States

Thus nuclear weapons, in concert with other arms, should provide a sort of extended deterrent, the cautionary impact of which must be felt before crises are reached. At the same time, they must not provoke or exacerbate crises. As a result, neither cutbacks nor increases in hardware will lead automatically to a safer situation. We must look carefully at the interplay of arms decisions with the institutions involved if we want to enhance safety.

Nuclear weapons were bound to come. Our physics world and our political world would have conspired to bring them about, if not at Alamogordo and Hiroshima, then elsewhere. Robert Oppenheimer and company were not any more responsible than anyone else for bringing in the atomic age. We all build atomic bombs, as we all build the institutions that demand them.

How will improvement come? The fundamental goal is the attainment of a more widespread realization that security exists only if it is shared by those we regard as our enemies. Weapons hardware restrictions play a role in bringing this goal about, but weapons hardware also provides the spur to make progress. The laboratories' role in this process is unlikely to please every part of the political spectrum. It must be guided by the centrist compromise which the country has chosen and which I think is the only sensible route. ☐

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1. For a clear presentation of the goals of U.S. strategic capability, see Harold Brown, Department of Defense, "Annual Report for Fiscal Year 1980," pp. 74 ff.

2. Michael May, "The U.S.-Soviet Approach to Nuclear Weapons," *International Security*, 9, no. 4 (Spring 1985).

3. Gerald E. Marsh, "No Evidence of Cheating," *Bulletin* (March 1983), p. 4.

4. Hugh E. DeWitt, "Labs Drive the Arms Race," *Bulletin* (Nov. 1984), pp. 40–42.

5. John D. Immele, "A Missile Deal for Europe – and Beyond," *Washington Post* (Jan. 13, 1984), p. A23.

6. Herbert York, "Nuclear Weapon Test Bans," in *Arms Control in Transition, Proceedings of the Livermore Arms Control Conference* (Boulder, Colorado: Westview Press, 1983), pp. 71–78.

7. For further discussions see G. Allison, A. Carnesale, J. Nye, eds., *Hawks, Doves, and Owls: An Agenda for Avoiding Nuclear War* (New York: W.W. Norton, 1985). This point was also made by Konstantin Chernenko (*Pravda*, March 3, 1984), one of a number of similar statements by Soviet leaders over many years. For a general examination of Soviet views about the uses of military power in the nuclear age, see David Holloway, *The Soviet Union and the Arms Race*, (New Haven, Connecticut: Yale University Press, 1983).

## STATEMENT OF DR. C. PAUL ROBINSON, PRINCIPAL ASSOCIATE DIRECTOR FOR NATIONAL SECURITY PROGRAMS, LOS ALAMOS NATIONAL LABORATORY

Dr. Robinson. Thank you very much, Madam Chairman. It is indeed a pleasure for me to appear before you today. I prepared a formal statement, which I would like to submit for the record.

Mrs. Byron. We will.

Dr. Robinson. If I may spend my time this afternoon just talking informally about my thoughts regarding nuclear weapons and test bans.

At Los Alamos I am responsible for our nuclear weapons research and development, the test program, nonnuclear munitions, the strategic defense initiatives, weapons advance research concepts, and also our verification and arms control technologies.

I must say today's subject provides quite a challenge for me in communications. The two sides are quite polarized on the issue. The arguments for testing are for the most part highly technical and analytical. The arguments against are primarily political judgments, and I must admit, with some emotionalism.

At Los Alamos, the first nuclear weapons were developed more than 40 years ago. Also, the first thermonuclear weapons, and today two-thirds of the stockpile that is out there was defined and developed at Los Alamos.

Let me state what must not be forgotten throughout this discussion: That the science of nuclear weapons is one of the most complicated technical disciplines in the world today. The physics of nuclear weapons remains a very amazing thing and a secret hid even from us by nature in many of its aspects. We expect it will challenge our understanding in the foreseeable future, just to be able to see and glimpse a few of the intricacies that make that energy release possible.

Now, the scientific method which I believe has provided a foundation for much of the modern world that we know is very specific. One should develop a hypothesis, test that hypothesis, and then examine your results and correct the hypothesis. If necessary, one then proceeds through that whole cycle once again. There has been no methodology for science which excludes experimental proof as a part, nor do I think there is any proof one could ever develop such a methodology.

Thus, for nuclear weapons I would like to state categorically that to impose limitations on that scientific testing means that one will live with uncertainties. Now, the degrees of that uncertainty are going to vary, depending upon whether it is a threshold test ban, which limits only your maximum yield, or a comprehensive test ban.

In the rest of my testimony today, I would like to concentrate on three areas:

First, the role of testing as we see it in weapons and R&D and certifications, and the understanding of nuclear weapons effects upon other systems.

Second, how test bans and other constraints affect the U.S. deterrent force.

And last, if you relate issues such as verification and the relationship, as some suggest, between testing and nonproliferation.

## CERTIFICATION

Let's begin by focusing on the word "certification." To certify a nuclear weapon we give a guarantee that these weapons will perform to specification throughout the stockpile life, not only if used in wartime, but possibly more importantly, in peacetime. They must be safe, and they must be resistant to unauthorized attempts to use them, such as by terrorists.

Certification is really our heaviest responsibility at the laboratories. It is a very complex process. It includes theory, calculations, a wide variety of test and experiments. It includes the calibration of the people who must do the work, as well as the instruments that will make measurements.

## EFFECT OF TEST BANS ON U.S. FORCES

In the process, I think nuclear testing plays not only a critical but an indispensible role. Only a nuclear test can prove the proper functioning of a weapon. We have also found no way to simulate exactly the environment except by carrying out the nuclear explosion. Today, of course, all of our tests are carried out underground because of concern for the world environment. All of our tests are fully contained. This is something that is a little asymmetrical. The Soviets do not completely contain their nuclear explosions and regularly release radioactivity from their tests.

All of our experience at Los Alamos in the past 40 years tells us that no new design ought be ever put into the stockpile if it could not be tested.

Now, some of the opponents of testing assert that that is exactly what they wanted to do, they wanted to prevent destabilizing weapons from being developed. They must realize the other side of the coin, that such a discrepancy prevents the development of weapons which will improve stability.

The world constantly changes and even the role and the character of the targets that we would hold at risk in the Soviet Union we have seen changing in a rather major manner over the last decade. Targets have increased in hardness, more mobile targets, a few deeply buried targets, a great emphasis on defense and defended targets, and finally, some hidden and disguised targets, so one could not know the coordinates.

A comprehensive test ban would prevent us from validating the weapons we would need to deter the Soviets under those changes. Some of these are maneuverable reentry vehicles which would be necessary to counter Soviet defenses.

Earth penetrating weapons to go after those deeply buried targets and other specialized weapons for the imprecisely located and mobile targets.

Just as Dr. Batzel said, a comprehensive test ban prevents development of some important weapons for Strategic Defense Initiative. Similarly, a test ban prevents us from making our own forces survivable against a Soviet counterforce strike. In particular, I have in mind the developments underway now of the Trident D-5 warhead, and the mobile land based missiles of the small ICBM.

Given these urgent military needs, a CTB should be of great concern. Considering how fallible human nature can be, and considering real life pressures, we would likely try to our best ability to stockpile new weapons, but not with an inadequate knowledge of their performance, or more importantly, an inadequate knowledge of their reliability.

On Friday, Dr. Thorn of our laboratory, who was present at Los Alamos as a weapons designer during the last moratorium, will be here to tell you some of the lessons of that time. We indeed did stockpile then some new nuclear weapons and serious problems did occur.

CTB would also prevent us from improving the safety, the important peacetime safety, of our nuclear weapons. Similarly, they would deny us making changes to put new controls to deny unauthorized use.

An area which I think has received too little attention in the past is the role of nuclear effects testing, those normally carried out under the overview of the Defense Nuclear Agency. They attempt to study and evaluate how nuclear explosions will affect other weapons systems as well as our command reconnaissance and other assets.

We are trying constantly to improve the hardness of our own weapons, our military hardware, and most importantly our command, control, communications and intelligence assets by which we hope to preserve a stable world.

Proponents of CTB would try and force us, by blocking the development of new weapons, to keep the same weapons we have today. In this we have great worries. Nuclear testing I think is an inseparable part of trying to maintain the very stockpile we have out there today. As I mentioned, the materials and warheads have been known to deteriorate over time. Radiation damage can be a major problem. Similarly, there is an inevitable migration of volatile chemicals within the weapons which can degrade other parts and require us to constantly disassemble weapons. From each major weapon system we will disassemble a significant quantity and analyze those quite often when those problems are found.

When those problems occur, they can be either of two types: One, that we know enough in the area we think it is OK, or we are going to have to undertake a substantial retrofit to try and fix the problem.

Now, even if we tried to just recreate the initial condition, as times change in the present stockpile, we find that you can't go back and obtain the same materials. Quite often a material will have been declared a carcinogen and will have vanished from the marketplace when it was used at an early part of the development program and has been stockpiled previously.

The judgments that are made as to whether those changes will require a test or not are a very critical part of the process. I think we can do well today because the personnel that makes those judgments are deeply immersed in ongoing R&D programs. Were they not, their judgments would be less valuable, less reliable, and indeed, I believe many of those important people would not remain active within the nuclear weapons program.

Again, there are graphic examples from the last moratorium of what happened during just 3 years. In recent times, we have similarly had major problems that occurred in stockpiles, but in our present testing regimen we are able to validate the results of changes as we fix the problems.

I would like to state for the record, to clear up a frequently expressed comment from proponents of test bans. They often suggest that since we rarely conduct proof tests of complete weapon systems pulled from the stockpile that testing is not really necessary to preserve the stockpile. Well, sometimes we do conduct just such classical proof tests, randomly drawing a weapon from the stockpile and, with no changes, placing it down hole for a detonation.

More often, we incorporate the tests of the hardware from a stockpile weapon incorporating into a more elaborate test so we can answer the question of a stockpile problem that has been observed, as well as taking important advanced data.

Let me turn now to discuss a little more of the problem of maintaining our design capability in all cases of human experiences, learning results from a series of trials and errors. I ask if we prohibit those trials, can sufficient learning ever take place?

We have had technologies we have tried to put on the shelf in the past. We have written elaborate reports and then later, when we found we needed them, as we put together a new crew of people and they came back in and picked up those reports. What is in the heads of the people reading the reports is not necessary what was in the heads of those writing the reports. Indeed, the evaluation and the training, the maintenance of competence within our people is an important part of the equation. Here again, the moratorium provided ample proof of the people problems that arise from lack of testing.

## VERIFICATION

In the final part of my remarks, let me say a few words about verification of test bans. I think I must note in the context of earlier remarks, that adequate verification, while it is a necessary element of going into a test ban treaty, I don't believe it is a sufficient one.

At Los Alamos we also work to try and improve verification technology as well as develop whole new methods for verification. The questionable record of Soviet compliance with past treaties places quite a heavy burden on us. We have got to do a much better job of reducing the uncertainties.

With the threshold test ban, we presently depend upon remote seismic monitoring. This method involves both random errors and systemic errors, such as the bias differences between geologic conditions at the Nevada site, and in the Shagan River complex, for example, in the Soviet Union. Thus, we can only monitor quite indirectly whatever seismic signals may emanate.

The measurement was uncertain whether they did or did not exceed 150 kilotons. The higher the central value we obtain, the higher probability that they have violated the treaty. At the 95-percent confidence level, we cannot determine if they violated the treaty by a factor of two. So conducting tests up to 300 kilotons, and there is still an appreciable probability that if they were to test at 450 kilotons, we would likely not report a violation. If we did, they could simply deny that they had done so and that would finish the matter.

With these shortcomings of the threshold test ban, we have been working and have developed a technique called corrtex, which uses the measurements of hydrodynamic shock locally on site at the testing area. The on site presence is, however, not very intrusive. A satellite hole is drilled parallel to the emplacement hole and it can sense the strong shock when the device is detonated.

Now, with this method to enhance the verification of the threshold test ban, we think we can reduce the error 30 percent of yield. I think this method responds well to President Reagan's call in his September 19, 1984 U.N. speech for direct on site but nonintrusive verification methods.

Verification of a comprehensive test ban is an entirely different undertaking. The detection of readily small seismic signals is very difficult to distinguish from a lot of natural background signals such as earthquakes. At lower levels of yield it appears possible one can disguise relatively large explosions. One can decouple in large cavities, one can use some shock mitigating materials around the device or hide the test by firing it in fact during an earthquake or use a whole combination of these.

We should not forget that under a comprehensive test ban one should worry, not about tests underground, or even in this country, but trying to protect and measure against clandestine tests in satellite countries, in the atmosphere, in space, or underwater.

It is a very difficult task. We are undertaking some technology developments on the present plate or high frequency seismic, which may indeed give us a better defense against decoupling. We are working on a low frequency sound system, or infrasound, and a method which senses ionosphere disturbances which result whenever a nuclear explosion is detonated either underground, underwater, or in the atmosphere.

Now, proponents of CTB's suggest that the superpowers' continued testing, encourages other states to develop nuclear weapons. Thus, continued testing will harm nonproliferation goals. I think these arguments are marginal at best. The driving force for other countries are fears for their own security, and in fact, for simple first generation nuclear weapons, testing is not as essential. To my knowledge, most nations who have gone nuclear have succeeded on the very first test with those simple devices.

In fact, I think arguments could very much go the other way. Our present friends and allies who depend upon America's nuclear umbrella if they perceive the U.S. deterrence was becoming unreliable due to our inability to test, they might well then decide to build their own and hence, we would have a reverse effect from what the proponents claim.

In summary, I think it is important in considering these bills, to undertake a risk/benefit analysis of the Nation's long-term security. I think if you will do so, you will find the risks are high. The benefits to be derived are for the most part hypothetical. Since they lie in political regimes, they can't be compared with the same concreteness or in the same terms as the technical risks I have tried to communicate today.

To impose a comprehensive test ban is to live with uncertainty about our most major weapon systems. I don't think we can afford to live with that uncertainty.

Thank you.

## PREPARED STATEMENT OF DR. C. PAUL ROBINSON

Chairman Byron, Members of the Panel, thank you for the opportunity to discuss with you the technical issues involved with nuclear weapons testing treaties and proposals. Our Laboratory has been operated by the University of California since 1943, originally as part of the Manhattan Project and now for the Department of Energy. The first nuclear and thermonuclear weapons were designed at our Laboratory, and over two-thirds of the nuclear weapons currently in the U.S. stockpile are Los Alamos designs. We know the tremendous destructive power of these weapons, and have long hoped that the world's leaders would find ways to reach effective arms control agreements. We were also pioneers of technical means of nuclear verification, including the ground-based Vela optical systems followed by the Vela satellites. However, the Laboratory also bears the responsibility of certifying the weapons we design. Certification is a guarantee from the nuclear weapon design laboratories that weapons will perform to specification throughout their stockpile life, in peacetime as well as in war. Equally important, it is a promise that they will be safe and resistant to unauthorized attempts to use them by terrorists. This is a grave responsibility.

### INTRODUCTION

Nuclear weapons are necessary today to provide the deterrence and, ultimately, the defense of the United States and our friends and allies. Even if we decide to alter the nature of our deterrent in the future, through development and deployment of effective strategic defenses, I believe that we will continue to rely for a long time on nuclear weapons. All of our experience at Los Alamos convinces me that continued research, development, and testing of nuclear weapons is essential if the United States is to continue to maintain and rely on the nuclear deterrent as we have known it, or on any likely alternative.

My testimony will address how nuclear testing relates to nuclear weapons R&D, certification, maintenance, and our understanding of nuclear weapons effects. I will also address how test bans and other constraints on the R&D and testing program would affect the U.S. nuclear deterrent. And I will discuss test ban issues such as verification, and the relationship of nuclear testing to arms control and nonproliferation, from my technical perspective.

### NUCLEAR WEAPON RESEARCH AND DEVELOPMENT

Nuclear weapons R&D is a partly theoretical, partly empirical process. In this R&D process, testing plays a critical role. Only nuclear tests allow us to determine the proper functioning of nuclear explosives. Calculations do not suffice, and there is no way experimentally to simulate the total performance of a nuclear weapon.

No new designs ought to be put into stockpile without testing. If enacted at this time, a CTB would reduce our confidence in important systems now under development, including the Trident II/D-5. Moreover, it would effectively prevent us from development of new weapons to make our deterrent force survivable; for example, through development and deployment of mobile land-based ICBMs (e.g. Midgetman). It would prevent us from validating the development of weapons that would allow us to respond to new requirements, such as those which may derive from the changes that are occuring in the targets we must hold at risk in the Soviet Union. These requirements might include using maneuverable re-entry vehicles (MaRVs) to counter deployed Soviet strategic defenses; developing earth penetrating weapons to hold at risk extremely hard, buried targets (missile silos, deep underground facilities); and developing effective means to hold at risk mobile and imprecisely located targets. A CTB would also prevent us from fully exploring nuclear concepts or technologies for strategic defense missions, whether we are looking to contributions they could make toward deterrence in a defense-dominant world or we merely wish to take prudent steps to protect our deterrent forces against a possible Soviet counterforce strategy.

In some cases we can adapt existing designs for use in other delivery systems. But we cannot always do so, either because the characteristics of the weapon are not appropriate, or because it is difficult to remanufacture old designs because the original materials are no longer available or production practices have changed. Even when in principle we could use old designs, this approach is inconsistent with experience. And there are good reasons why we would prefer to avoid this route in the future, most notably because an old warhead would not be optimized for the new delivery system. In the case of the small ICBM, where Congress has defined some system specifications, the penalties for using an existing warhead might be especially acute. The main penalty, which would probably be a lower yield for the warhead, might mean that the weapon system would not be able to carry out some of the missions for which it was intended or could be used.

Moreover, a CTB is of great concern because, given real life pressures and fallible human nature, we might occasionally stockpile new but ~~interesting~~ immature designs or allow inadequately reasoned changes in old ones. Experience shows that serious unreliability could result.

Of course, preventing the development of new generations of nuclear weapons is precisely what the proponents of testing limits have as their objective. However, testing has been and continues to be necessary for reducing the dangers and destructiveness of nuclear weapons. Indeed, testing is necessary for advancing our knowledge in desirable areas, without at the same time taking unreasonable risks. Nuclear testing allows us to make nuclear weapons safer, and to improve controls to prevent or deny unauthorized use. It allows us to improve design efficiency and reduce the cost and special nuclear material requirements of warheads, and also to design weapons to reduce collateral damage.

## UNDERSTANDING NUCLEAR WEAPON EFFECTS

Nuclear effects tests, primarily carried out by the Defense Nuclear Agency, contribute significantly to our ability to study the effects of nuclear explosions on our weapons systems, as well as on our command, communications, reconnaissance and other assets. This knowledge alows us to respond to the threat posed by Soviet offensive and defensive nuclear systems by hardening our weapons. It is also crucial to hardening our command control, communications, and intelligence ($C^3I$) capabilities, on which we increasingly rely to avoid war, to manage crises, to maintain the credibility of our deterrent and, in the event of war, to assure our defense.

Periodic testing is necessary not only to understand the effects of nuclear explosions on our weapons and $C^3I$, but also to allow us to understand and use those weapon effects that might best destroy Soviet targets. As I suggested, there are changes in the physical characteristics (hardness, location error, etc.) of key targets which the U.S. must hold at risk in order to ensure deterrence. These changes pose new problems for U.S. weapons. To ensure that we could destroy buried or hardened Soviet $C^3$ assets or missile silos, we need to know more about the cratering, ground shock, source region electromagnetic pulse, and other phenomena associated with nuclear explosions. To be able to hold at risk mobile Soviet weapons and support capabilities, we need to know more about the generation of microwave radiation by nuclear explosions. These are examples of how changing requirements placed on our military forces lead us to rethink and modify our nuclear weapons on the basis of our understanding of nuclear effects.

## MAINTENANCE OF THE NUCLEAR WEAPON STOCKPILE

Nuclear testing is essential for the maintenance of the stockpile. Nuclear weapons are affected significantly by aging and obsolescence. Over an extended period, the materials used in warheads deteriorate physically. Expected stockpile lifetimes for warheads now are typically between 15 and 25 years, but some designs have required corrective measures much sooner. In the past, new weapons usually replaced those in the stockpile before the older weapons deteriorated. But without nuclear testing, the possible effects of physical deterioration would become increasingly important.

Maintenance of the nuclear stockpile depends on regularly scheduled random sampling, in which nuclear weapons are disassembled and inspected. When a weapon becomes suspect upon inspection, the problem normally is referred to the responsible weapon design laboratory, preferably to the designers of that particular weapon. In the vast majority of cases, this process leads to a recommendation that may range from ignoring the observation entirely to a substantial retrofit of weapons in which the troubling symptoms have been discovered. The recommendations in general are made with high confidence, because the design personnel involved are immersed in the ongoing research, development, and testing program and have the benefit of a continuing flow of test results. Their design decisions thus are persuasively validated (or challenged) by current as well as past experiments. Most of these decisions can be implemented without further testing, restoring the weapon system in question to a high assessed reliability.

Occasionally, however, it is determined that a weapon must be modified in ways that are serious enough to raise the question of a nuclear test. I must stress that this is a difficult and costly decision, but it sometimes has been necessary, in spite of assertions by some CTB proponents that this has never occurred. The record is well documented refuting their claim; it has not been possible to solve all of the problems revealed by stockpile surveillance without additional testing.

In addition to those cases where the necessity for a test was evident, and the testing was done, there have been considerably more troublesome incidents in the past in which the decision went the other way. A test was considered unnecessary, but this judgment was later discovered, usually through the test of a related nuclear device, to be in error. In those cases, confidence in the weapon system involved was undiminished until the error was discovered, but it was misplaced.

Under a comprehensive test ban, given real life pressures and human fallibility, we might on occasion make inadvisable changes or stockpile inadequately tested designs. Human judgment is critical to our confidence in nuclear weapons. It is clear that confidence in the reliability of our weapons ultimately is based on confidence in the design judgments that must be made from week to week. If those judgments were to become divorced from experimental validation for any extended period, our confidence in them would deteriorate. This could also lead to an increase in numbers of weapons to make up for declining confidence, or the development of even more lethal, non-nuclear weapons. Equally dangerous, I believe, is the likelihood that as time went on we would grow increasingly unaware of our own limitations, as happened during the 1958-1961 motatorium. We could end up with a "deterrent" that resembled the emperor's new clothes, and our enemies might well preceive that we were naked.

A frequently expressed but incorrect notion should be specifically dispelled. The fact that we rarely conduct "proof" tests--that is, specific individual tests of weapons pulled from the stockpile--is sometimes cited as evidence that testing is not necessary to maintain confidence in the reliability of the stockpile. This is misleading. Sometimes we do conduct classical proof tests, pulling a weapon directly from the stockpile. In addition, we use the continuing testing program to confirm the design choices made in stockpile weapons, and we reuse the tested technology of weapons in the stockpile to design new weapon systems. If we encounter a stockpile problem, we may proof test its solution by adding an experiment to a test that is part of the continuing program. In effect, continuous proof testing is the basis of our entire testing program.

Let us also consider the prospect of the so-called "wooden weapon," references which appear in the statements and writings of some CTB proponents. We believe that it may be possible to design such a weapon, designed as one that could be relied on with a high and justifiable degree of confidence for a long period, in the absence of a nuclear design technology base. We even have undertaken some preliminary design studies. It must be realized, however, that if (and that remains an unknown today) an extensive testing program proved out such weapons, their characteristics would almost certainly be very different from those of today. We also know enough about such design concepts to state that none of the major U.S. systems on which we rely at the present time would be able to deliver them to target. A massive redesign and rebuilding program of enormous cost would be necessary. Perhaps most importantly, such weapons probably could not be adapted at all to what most people see as the most stabilizing part of our force structure, the sea-based missile systems. It is those systems that have placed the most stringent demands on our design and fabrication technologies, and it consequently is those systems that rely most heavily on the continued competency of our nuclear weapon technology base.

## MAINTENANCE OF A NUCLEAR DESIGN AND TESTING CAPABILITY

Not only is nuclear testing essential to the maintenance of the nuclear stockpile, but the U.S. nuclear weapons laboratories have maintained for years on the basis of this experience that testing programs are essential in maintaining the nuclear weapons design capability of the nation. Without an experimental testing program that challenges our nuclear weapon designers and tests their designs, we would lose our best designers. Those remaining would not be able to demonstrate the validity of their theories. This was our experience during the test moratorium. In effect, over a period of years, we would expect the technical base of knowledge and experience required for developing and maintaining weapons to dissipate and disappear.

## EFFECTS OF ARMS CONTROL CONSTRAINTS

The ratification of the Threshold Test Ban Treaty would have very different effects on the Laboratory from a comprehensive test ban. The TTBT, signed in 1974, establishes a nuclear "threshold" by prohibiting tests with a yield exceeding 150 kt. The U.S., as I have indicated, observes the 150-kt threshold scrupulously. Within this limit, the Laboratory is able to maintain the present stockpile and our nuclear design capability.

Without testing over 150 kt, we can also within limits, undertake risk-free modifications of nuclear weapons to enhance safety, improve efficiency (yield-to-weight ratio), reduce cost, tailor effects to reduce collateral damage, and achieve other design improvements. As well, needed nuclear effects testing can be undertaken. The Laboratory can design, produce and certify new weapons with high confidence if they are 150 kt or less, or with lessening confidence if they are not larger than the threshold by approximately a factor of two, or if essential aspects of the design have been tested in the past at higher yields. The Laboratory will not be able to design and develop new high-yield weapons that depart significantly from past, tested designs; but unless the U.S. establishes new high-yield weapons requirements, we can live with such restrictions on our own program. However, we are concerned about what the Soviets can do under the TTBT. And, the TTBT does pose some formidable problems for evaluating certain nuclear concepts for the strategic defense mission--for example, those that might require a large-yield nuclear weapon as a power source--although such concepts are not the main focus of SDI.

In summary, while we are able to effectively carry out our national security mission under the strictures of the TTBT, we could not do so under a CTB. A CTB would lead to a loss of confidence in the reliability of our nuclear weapons and would result in substantial erosion of our capability to design, manufacture, and maintain them. A CTB would effectively preclude responsible and desirable modernization of the nuclear stockpile, and it would prevent desirable risk-free improvements to enhance the safety, efficiency, economy, and extended reliability of our nuclear weapons. As long as we depend upon nuclear weapons for deterrence and, ultimately, defense, these consequences of a CTB are highly undesirable. A CTB would also inhibit efforts to move away from our current reliance on offensive forces, and toward a posture that gave greater emphasis to defenses. A CTB would virtually halt all research on nuclear concepts for strategic defense. It would also remove our capability to evaluate the vulnerability of our stockpile to nuclear ABM systems currently deployed by the USSR. In general, a CTB would greatly constrain attempts to find a defense against ballistic missiles.

## TTBT VERIFICATION

Neither the TTBT nor a CTB is adequately verifiable, albeit for very different reasons. Before considering the verification problems concerning these treaties, let me place them in context. I believe that verification should be a crucial consideration in any decision on nuclear testing restraints. And it seems to me that this means we will have to consider not only the verification techniques and technologies available, but also the record of Soviet compliance with past and present arms control agreements. As you will see, we are working to improve existing verification technologies and to develop new ones, and we have identified several promising avenues of research for reducing uncertainties about Soviet behavior. Verification requirements are more stringent than might have been the case in the past.

For verification of the TTBT, the U.S. now depends upon remote teleseismic monitoring. This methodology includes random errors, as well as systematic errors such as the seismic "bias" between the Nevada Test Site (NTS) and the Shagan River test site. In light of these limitations, we simply cannot know what are the actual yields of Soviet underground tests. We are forced to infer them indirectly from the seismic signals resulting from the tests, and there is uncertainty in our inferences. We can only say with a certain probability--but no certainty--that a given test did or did not exceed the 150 kt threshold. More specifically, from each seismic measurement of a test, we can infer a central yield. But because of inaccuracies in our measurement techniques, we can only say that the actual yield was probably within a fairly broad range above or below the inferred central yield. The higher above 150 kt the central yield is estimated to be, the lower the probability that the test was actually in compliance with the TTBT's threshold. But to have adequate confidence that a given test exceeded the threshold, the central yield estimate must be very high indeed.

We have not, however, given up hope on the verification of the TTBT. On the contrary, at Los Alamos and elsewhere there are explorations of new and improved verification methodologies that have the potential for increasing confidence in our ability to determine and guarantee Soviet compliance with the TTBT. Remote teleseismic devices and analysis methods have been extensively investigated. These are now being extended to consider high-frequency portions of seismic signals, which only recently have been examined, and which may offer greater possibilities for accurate monitoring of tests. Other new techniques are being investigated, including measurements of sound waves and ionospheric disturbances caused by nuclear explosions underground. A technique called CORRTEX (a hydrodynamic shock measurement) has been developed and used by Los Alamos National Laboratory for on-site measurement of nuclear test yields. Providing a direct and much more precise estimate of yield than any remote technique, and having no systematic "bias" errors, it appears especially promising. If application of this technique were allowed by the Soviets, it could provide much improved confidence that they were abiding by the terms of a threshold test ban. In addition, this method eventually could help resolve some of the major uncertainties and ambiguities in remote monitoring data, by providing a continuous flow of calibration measurements on nuclear test events. This technique could be used to respond to President Reagan's call, in his September 1984 speech to the

General Assembly of the United Nations, for direct on-site but nonintrusive verification of compliance with the TTBT.

CTB VERIFICATION

Verification concerns with a comprehensive test ban involve a different range of yields than with a TTBT. In essence, the problem of verifying a CTB is detection of relatively small seismic events and the unequivocal identification of their source. As seismic magnitude decreases, the number of naturally occurring events during any period increases dramatically. Given this fundamental fact, under a CTB even greater verification difficulties would beset us than under a TTBT, especially if we were largely dependent upon remote teleseismic monitoring.

All experts agree that there is some lower limit below which nuclear tests in hard rock cannot be detected and identified with remote seismic monitors; the usual figures cited are one, two, or at most a few kilotons depending on the conditions. Proponents of a CTB argue that this is sufficient to assure compliance. But it is possible to disguise tests of relatively large nuclear weapons to make them appear (to remote monitors) relatively small or to be something other than a nuclear test. By exploding a device inside an underground cavity, for example, most of the energy from the explosion is not "coupled" into the earth and does not initiate seismic signals. Hiding explosions in earthquakes, or using shock-mitigating materials, may confuse the issue of decoupling even further. A militarily significant nuclear test program conducted in this way could be unrecognized by a network of remote teleseismic monitoring stations. Further, a CTB could require a much more extensive monitoring network than now exists, because we would have to protect against the possibility of a violator conducting tests clandestinely underwater, in the atmosphere, and in outer space, as well as underground.

Indicating that current nuclear testing verification technologies have significant limitations does not mean that nuclear testing restraints will remain unverifiable forever. On the contrary, it suggests that serious work needs to be devoted to new and improved technologies. At the moment, two directions for verification R&D are clearly indicated: augmenting remote monitors with on-site techniques, which I believe are necessary but not sufficient, and improving remote monitoring techniques themselves. Work is proceeding in both directions at the U.S. nuclear weapons laboratories and other places. As I indicated, a promising verification method that senses the ionospheric disturbances produced by nuclear explosions is being developed by Los Alamos. And, high-frequency seismic signals may hold promise for increasing sensitivity to decoupled tests, although this remains to be demonstrated.

## CTB AND ARMS CONTROL

The proponents of test bans have often made exaggerated claims about the value of a CTB. It is frequently suggested or asserted that a carefully negotiated, binding, and fully verifiable CTB could be the breakthrough that would result in genuine arms control through reductions in nuclear arsenals. However, even the staunchest proponents of a comprehensive test ban have recognized that a CTB will not by itself end the arms race and will not result in a reduction of nuclear weapons and their decommissioning and dismantlement. We must wonder, then, how this oblique approach of the CTB proponents would resolve those very real political and military-strategic differences that have been the stumbling blocks in previous strategic and theater arms control negotiations. For it is clear that many of the same obstacles that have prevented significant nuclear arms reductions also stand in the way of agreeing to a CTB. If a way could be found to overcome those obstacles, it would probably best serve our arms control objectives to move directly to the negotiation of strategic and theater nuclear arms reduction agreements. In the end, to focus on a CTB as the goal of arms control policy seems to me to work the wrong side of the problem.

## A CTB, NONPROLIFERATION, AND THE NPT

It is also doubtful that a CTB would significantly improve the nonproliferation regime. We frequently hear that the failure of the superpowers to end testing provides a stimulus for other states to build weapons. Calls for a CTB often point to the preamble to the 1968 Nuclear Non-Proliferation Treaty (NPT), in which the nuclear-weapon states recalled their determination to seek the cessation of all test explosions. From a technical perspective a comprehensive test ban can have at best a marginal effect on the proliferation of nuclear weapons. Testing is not essential for designing and building the simple, first-generation fission devices that a would-be proliferator is likely to want at the beginning of a nuclear weapons program. He needs only the money, the special nuclear material, and the knowledge and skills to assemble the device. Most, if not all, of the nations that have built nuclear explosives are believed to have detonated them on the first try. By complying with a comprehensive test ban, a would-be proliferator would not be depriving himself of the capability to develop nuclear weapons should he see these as essential to his national security or military ambitions. He would only be sacrificing the "prestige" or "warning" value he might see in carrying out a public explosion.

It is also argued that a nondiscriminatory comprehensive test ban, signed by nuclear and non-nuclear weapon states alike, would inhibit the spread of nuclear weapons by making tests of nuclear explosives politically more costly than they already are. In the view of CTB proponents, conclusion of a comprehensive test ban treaty would demonstrate the United States' commitment to fulfill its NPT obligations. With the NPT Review Conference currently in session, they argue that movement toward a CTB would prevent further erosion of support for the NPT and increase the attractiveness of the Treaty for "holdout" states. While a CTB might--and I stress "might"--have marginal, short-term benefits for the NPT, it is unlikely to have a significant long-term effect on the problem of proliferation and the strength of the nonproliferation regime. It is unlikely that the states interested in building nuclear weapons are driven primarily by the actions of the major powers. Like the nuclear powers, they are assuredly driven by their own security requirements. Thus, a comprehensive test ban is unlikely to prevent a country from deciding to develop nuclear weapons if it believes it can and should do so. Nor would it eliminate nuclear weapons, and thereby end the distinction between the nuclear and non-nuclear-weapon states. And it would not prevent the superpowers from developing new types of non-nuclear weapons equally out of reach of the present non-nuclear-weapon states. Finally, present allies, who depend upon the U.S.'s nulear umbrella, might in fact want to develop their own nuclear weapons as they perceived the U.S. stockpile becoming unreliable due to our inability to test effectively reversing any nonproliferation advantages.

## SUMMARY

In summary, if one attempts to undertake a risk/benefit analysis of a comprehensive test ban as regards our nation's long-term security, the risks are high. Past history, as well as the basic structure of the scientific and engineering processes by which our nuclear weapons are designed and maintained, argue against the elimination of testing. Although we cannot quantify these risks in every case, they can be substantial. What is worse is that major uncertainties are unavoidable unless tests are carried out to eliminate them, as is the case under today's testing regimen. A more in-depth discussion, including classified topics, could, I believe, add additional insight to these issues than is possible at present.

Finally, the questions of benefits to be accrued from a CTB , if any, are hypothetical. Unfortunally, preceived benefits lie in political regimes and cannot be readily compared in the same terms or with the same concreteness as the technical risks I have testified to here.

Mrs. **Byron**. Thank you very much.

Let me pursue a line of questioning that I was concerned about this morning and that Dr. Batzel touched on quite extensively, but it is something that worries me and I think we have talked about it, and that is the problem with experienced personnel and where we are going to go if we once again go into a comprehensive test ban.

I think during the 1958-1961 moratorium, we lost a good many talented people within the program. I see that that would probably transpire once again when we are in a diminishing supply situation of talented young scientists, and we have talked many times about the challenges that within our national labs are the one motivating force keeping many of the people in those areas, because as we have said, it is not the salary or working conditions.

Do you feel that that would once again be a case in point in your area? Dr. Robinson.

## SHORTAGE OF YOUNG SCIENTISTS

Dr. **Robinson**. During the last moratorium, which came just after the developments of the thermonuclear warheads, there were many questions on the table. What we found among the theorists were that failing to get answers for those questions for several years, they decided it was not worth pursuing. Many of them left the laboratory. Dr. Thorn, whom you will hear from on Friday, was within 1 week of leaving. He had accepted a new job on the east coast, when the Soviets fired their test on September 1.

The experimental people we tried at both labs to utilize in other programs. We started the Rover nuclear rocket program, and the Pluto nuclear aircraft engine, and the testing people indeed were kept at a level that could keep their interests and keep their talents honed; but particularly among the theoretical designers, it was a very bleak situation. We lost a lot of them. I am certain that would happen again today.

Mrs. **Byron**. I think you stated that certification throughout the stockpile life is essential and yet we we randomly pulled weapons out of the stockpile, and I think Dr. Batzel stated or testified that there became some real problems with some of those weapons that have to be pulled out of the stockpile. What does that do to the certification aspects?

Dr. **Batzel**. What that means is that we look at the degradation of the warhead and then we go through a detailed evaluation of that degradation. That puts a special burden on your skilled, experienced people to evaluate the consequences of that deterioration and to make a judgment, and that kind of judgment is made only after many calculations, much study, looking at comparable situations, if we have them, and trying to make very sure that if we judge that degradation we can look for, that that judgment is valid, and that again we are essentially in a recertification situation. Namely, we go through the detailed process to make sure as best we can that our judgments are sound.

If we have significant worries after looking at that degradation, and we see a need to correct it, then we will certainly initiate preparations and conduct an actual nuclear experiment so that we can, in fact, recertify that particular weapon.

Mrs. **Byron**. A followup, with a comprehensive test ban—would it hurt our ability to maintain our nuclear arsenal probably more than it would the Soviets?

Dr. **Batzel**. That is my view.

Dr. **Robinson**. We think with the Soviets, with their larger throw-weight, can accommodate changes that require putting in more special nuclear material, more high explosives.

I would also add, Mrs. Byron, that during the last moratorium, we were putting in a stockpile which would usually stay for 3 to 5 years before it would be replaced. Today, we are trying to design a stockpile that will stay in at least 15 years, and some systems 25. That puts a much greater burden and more opportunity for long-term deterioration to take effect. It is a worse problem today.

Mrs. **Byron**. I think it has been stated that low-yield tests might probably assist the Soviets in testing the triggered stages of nuclear weapons. At the same time, such a test ban might not be important now but it could be if a comprehensive test ban is in effect. Could you elaborate a little bit more on that proposal?

### LOW-YIELD NUCLEAR TESTS

Dr. **Batzel**. Well, the issue of low-yield nuclear tests, some low-yield tests would in some situation resolve questions, but not in all situations that we have observed. Low-yield nuclear tests, the ability to conduct those, certainly would be important in maintaining a capability and interest of the nuclear designers, so an ability to conduct low-yield nuclear tests is important.

Dr. **Robinson**. Let me add to that. Our weapon stage, the energy from low energy of high explosive upward to fission and thermonuclear stages, those very first stages are crucial and they are where some of the major uncertainties and understanding of the physics of nuclear weapons lie. Thus, if you develop a problem in that stage and it doesn't work, nothing above it will work and so it is crucial that the first stages do operate. But yet we have a great lack of knowledge as to the processes which go on in those stages.

Mrs. **Byron**. You talked a little about the people problem. We talk about the stockpile problems. Let me talk about the cost of the test ban. Have we gotten to a point now that it is almost becoming prohibitive for testing because of the cost? I know we have cut back fairly dramatically on the number of tests that we have been able to maintain. I know you are in your development stages. It is very difficult to get the timeframe in the test field, at the same time looking at the budget constraints to get the costs available to make the tests that are necessary in the development program. Could you touch a little bit on that?

Dr. **Batzel**. Well, the nuclear tests we conduct today are fundamental to the program. We do derive considerably more information from each nuclear experiment than we did historically, so the number of tests we conduct, while we feel it is too small a number, is certainly significant and important, and my view of the current level is that while we have experiments we cannot conduct, we certainly have a viable nuclear weapons research and development program.

Mrs. BYRON. Are we putting two and three and four different tests on one initial shot?

Dr. BATZEL. We usually have what we call add-on experiments which take advantage of a single nuclear explosion to conduct a series of experiments.

Mrs. BYRON. Mr. Ray.

Mr. RAY. No questions.

Mrs. BYRON. Mr. Stratton.

Mr. STRATTON. Thank you, Madam Chairman.

I am not sure that this is totally appropros of the purpose of this hearing but I wanted to ask Dr. Batzel a question. I had understood that the widow of Dr. Lawrence, for whom Lawrence Livermore Laboratory is named, is desirous of getting his name off the name of the institution. I wondered if that was a correct bit of information that I had gotten, and I would like to know is she opposed to the mission of Lawrence Livermore National Laboratory?

Dr. BATZEL. Mollie Lawrence is a fine lady, but she does not agree with the mission of the Lawrence Livermore National Laboratory. History is many times in the minds of the observer. Herbert York, the first director of the laboratory, who worked very closely with Ernest Lawrence, remembers him a little differently; namely, that Ernest Lawrence was a major motivator in the establishment of the laboratory, took a personal interest in it, and the rest of the history, at least as I understand it, is that Ernest and his name association with the laboratory makes a lot of sense.

Mrs. BYRON. Was it not true that that laboratory was named during his lifetime and he was rather proud of the honor?

Dr. BATZEL. I think Lawrence's name really came along a little later. His association, the association of that name, was part of the Lawrence-Berkeley Laboratory for a while and then was split from that laboratory in 1971.

Mr. STRATTON. Well, in a situation like this, does the widow necessarily have priority over the wishes of the individual who has apparently over his lifetime broached no objection to it? Has that been explored, Doctor?

Dr. BATZEL. That has been discussed. I am not sure it has been explored.

Mr. STRATTON. Do you have any good spiritualists who might be able to get the doctor's views?

Dr. BATZEL. Not that I know of.

Mr. STRATTON. You do all kinds of things out there.

Dr. BATZEL. That is a little beyond us.

Mrs. BYRON. Mr. Courter.

Mr. COURTER. No questions.

Mrs. BYRON. Let me thank both of you gentlemen for your testimony today. I appreciate the time and the valuable dialog that we have had here today, and you will now go back and try to find a little soothsayer that can get us vibrations on whether he is happy with it or not. Your mission you have in front of you.

Dr. BATZEL. Thank you.

Mrs. BYRON. We will now go into the second witness this afternoon, Dr. Robert Rubenstein, who is the Director of the Weapons

Intelligence Divison Office of the Scientific and Technology Intelligence, Department of Energy, and for your testimony, I understand that it is to be a closed session, so under the authority granted the chair, on Tuesday, September 10, the subcommittee will now go into closed session for national security reasons, and we will take a few minutes to clear the room.

[Whereupon, at 3:10 p.m., panel proceeded to other business.]

[The following insert was provided for the record during the closed session:]

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# Some Little-Publicized Difficulties with a Nuclear Freeze

October 1983

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# I. INTRODUCTION

Various persons in the United States and elsewhere have proposed a seemingly simple beginning to further arms control--a "mutual, verifiable U.S.-Soviet nuclear-arms freeze." The present movement for a nuclear freeze received early promotion with the brief tract Call to Halt the Nuclear Arms Race by Randall Forsberg, first published April 1980 by the Institute for Defense and Disarmament Studies. This was expanded in the November 1982 issue of Scientific American in an article by Forsberg, "A Bilateral Nuclear-Weapon Freeze." Further writings have included a report entitled "Model Freeze," which appeared as the September 1982 issue of F.A.S. Public Interest Report, a journal of the Federation of American Scientists. A more recent discussion is presented in Seeds of Promise (published by Brick House Publishing Company), which is mainly a transcript of hearings in September 1982 organized by the Federation of American Scientists.

To persons who are not well-informed on many aspects of nuclear weapons, the proposed freeze appears to offer a simple, safe start toward desirable future reductions in nuclear arms. Actually, it does not. There are a great number of difficulties and hazards that would accompany the freeze as proposed--difficulties in negotiability, verification, and in the resulting strategic balance. This paper will put aside most of these serious, probably fatal, difficulties with the proposed freeze and discuss only one limited but potentially crucial aspect--the maintenance of a reliable nuclear weapon stockpile.

## II. THREE PARTICULAR BANS PROPOSED FOR A FREEZE

Three particular, interrelated bans relative to nuclear warheads have been put forward as parts of a freeze. The bans are three of the several freeze components presented in *Call to Halt the Nuclear Arms Race* and are stated or implied components of most other freeze proposals. These three propositions are individually impractical, and in combination, they present significant dangers. These proposed parts of a nuclear freeze would ban:

(1) any production of weapon-grade nuclear material for weapon purposes;

(2) any manufacture of nuclear weapons, and

(3) any tests of nuclear explosives.

To most non-specialists these prohibitions would appear reasonable and desirable. They seem to be plausible means to prevent the addition of further weapons to the U.S. and Soviet inventories. But, there are important objections that relate to a vital precaution for the U.S. in arms control: the U.S. should avoid any important loss of its ability to *deter* nuclear attack or major war. These three particular proposed bans could actually promote unilateral disarmament by the U.S. and potentially dissipate U.S. deterrence of the Soviet Union.

The basic problem with the three proposed bans is that they severely undercut the capability of the U.S. to maintain a reliable nuclear weapon stockpile. Judging from past experience, we can expect that, with time, significant uncertainties will arise about the operability of many nuclear weapons in stockpile. Worse than that, there could arise the definite certainty that some particular weapons would not operate, perhaps all weapons of a particular type. If the U.S. cannot maintain a reliable nuclear stockpile, it is unlikely that the U.S. can maintain a dependable strategic deterrent.

The problem is simple: nuclear weapons are very complex devices that are perishable; they deteriorate and become inoperable. U.S. experience has been that often nuclear weapons must be rebuilt to be maintained in operable condition. This rebuilding of nuclear weapons requires the same sort of facilities as are used in their initial manufacture. The maintenance and operation of such facilities would be banned under the proposed freeze on production of nuclear weapons.

To correct some problems found in stockpile, there may be need to add further nuclear material to a weapon type. The production of this weapon-grade nuclear material would not be permitted under the proposed freeze on the production of nuclear material for nuclear weapon purposes.

Adequate assessment of deterioration that is observed in stockpile and assessment of possible corrective measures can at times require nuclear tests. Weapon experts have stated that the U.S. cannot maintain a reliable nuclear weapon stockpile without the opportunity to test, an opportunity that would be foreclosed under the freeze on testing of nuclear weapons.

All of these requirements for maintenance of a reliable stockpile would be denied the U.S. under the proposed freeze: there would be no production of weapon-grade nuclear material for weapon purposes, no facilities for fabrication of nuclear weapons (and so no facilities for re-fabrication of nuclear weapons), and no testing of nuclear explosives. The sections below consider these prohibitions in more detail and point out their incompatibility with maintaining a reliable deterrent. In this, the discussion draws on some important past examples of problems with the U.S. nuclear stockpile.

## III. THE PERISHABILITY OF NUCLEAR WEAPONS

### 1. GENERAL

Like other, very much simpler equipment such as automobiles and home appliances, nuclear weapons deteriorate with time. For nuclear weapons, it is not necessarily a matter of "wearing out": they are required to operate only once. There is essentially no wear except for that associated with their transport and handling. However, like some home appliances that have been stored unused in a family's basement, when they are closely inspected they may be found to have deteriorated into an unusable condition.

This susceptibility to deterioration tends to be much higher for nuclear weapons than for other equipment. Various features of their design must be guided mainly by the desired weapon performance and by safety considerations rather than by demands for resistance to deterioration. Many of the weapon materials have a low resistance to deterioration. Certain chemically reactive materials are inherently required in nuclear weapons, such as uranium or plutonium, high explosives, and plastics. The fissile materials, both plutonium and uranium, are subject to corrosion. Plastic-bonded high explosives and other plastics tend to decompose over extended periods of time.

Deterioration can take various forms: portions of materials can dissociate into simpler substances. Vapors given off by one material can migrate to another region of the weapon and react chemically there. One potential source of effluent is the thermonuclear fuel lithium deuteride, which can react with water vapor and release hydrogen gas. Materials in the warhead electrical system such as insulators, batteries, capacitors, squibs, and lubricants can produce effluents that can migrate to regions in the nuclear explosive portion of a weapon.

Over an extended period of time, plastic components in the explosive portion of a weapon can be the source of effluents. These components include plastic-bonded explosives and plastic pads and cushions. The plastics may decompose, or they may give off gases with which they were impregnated during production processes.

As one form of deterioration, corrosion can create fissures and perforations that would have undesirable effects on weapon operation. Mechanical components can have unacceptable friction introduced by corrosion or by other chemical effects. Corrosion products can flake off the surface of some components, and vibration and other movements of the weapon can distribute these flakes ("dust") to locations where they could spoil the weapon's operation.

The characteristics of high explosives can change with time. Materials can creep and become distorted. Vital electrical components can change in character; electrical circuits can open or become shorted. Some changes can be such that they will obviously cause a weapon to dud; other changes can be more subtle, and their effects on weapon performance can be difficult to predict.

The weapon developers have seen and studied many past examples of deterioration and have applied what they have learned to the detailed design of new weapons. However, while the materials scientists and weapon engineers have given great attention to improving the resistance of weapons to deterioration, there is no means to prevent it absolutely. In any event, many examples of earlier technology will remain in the stockpile.

Despite efforts to lengthen the service life of weapons, there is general agreement that an effective life of more than 20 years or so is doubtful and that some weapons may show unexpected early deterioration, as has happened in the past. As matters stand, many of the weapons in stockpile are approaching an age where their continued ability to function will become increasingly questionable.

## 2. RESPONSES TO DETERIORATION

Past U.S. practice has been to monitor the nuclear stockpile closely in order to detect any deterioration at an early stage. This monitoring involves a regular sample inspection of samples of each weapon type in stockpile. This requires the disassembly of a weapon and the inspection of its internal components. The disassembly is not simple; it is not a matter of undoing some bolts and screws to separate the various parts. U.S. nuclear warheads in large part are brazed, welded, and cemented together. To disassemble a modern weapon is to destroy it; many portions have to be machined apart. Few of the components could be reassembled and used again in a rebuilt weapon. Generally only the nuclear material is worth recovering, and the fissile material usually must be melted down if it is to be refabricated into a weapon.

The weapon-sampling operations in the U.S. have involved considerable use of the weapon production facilities. The initial major disassembly is done at the complex of facilities that are used for final assembly during weapon production. Component parts are then usually disassembled elsewhere, likely at the facilities where they were originally assembled. In this way, the handling fixtures, gauges, and other equipment used in the production of the weapons are potentially available for use in the disassembly and inspection operations.

While there is no absolute requirement that the same facilities be used for weapon disassembly and inspection that are used for weapon production, there are distinct benefits and conveniences from this dual use. There would probably be no achievable arms-control benefit from requiring that the facilities be different. Adequate stockpile sampling requires substantial facilities for the disassembly and inspection operations. If such facilities are permitted, they could potentially be used clandestinely for production of new weapons. Certainly, such facilities could not be well monitored: it is unimaginable that stockpile-sampling operations would be opened to inspection by foreign personnel.

3. TESTING

Leaving aside the development of new warheads, the U.S. needs a nuclear test program in order to monitor and maintain the U.S. nuclear stockpile effectively. Such tests, which would be banned under the proposed freeze, would at times be required to determine the effects of the deterioration that is observed and to evaluate possible corrections of the weapon design. Weapon scientists may propose design changes in order to ameliorate the effects of the deterioration without a complete rebuilding. If a major rebuilding is necessary, the weapon scientists may need to alter the design in order to avoid an early repetition of the deterioration. Any design changes present some degree of uncertainty, which may need to be resolved by nuclear test.

If U.S. weapon scientists observe serious deterioration when there is a prohibition of nuclear testing, the possibilities for effective response would be much more limited and more uncertain than they would be with nuclear tests. Unless there were strong reason to do otherwise, the weapon managers would need to accept the worst credible estimate of the consequences of the observed defects and to respond accordingly. For deterioration that potentially would reduce the yield significantly, the DoE would need either to substitute a different model warhead or to rebuild the existing model. Either choice demands new weapon production, which is inconsistent with the proposed freeze.

The substitution of a different warhead would probably involve a great time delay. To use another warhead model requires adapting that model to the particular carrier vehicle. Such adaptation usually necessitates a considerable development program--for example, one that requires developmental flight tests, which are not permitted under the proposed freeze. The adaptation of a different warhead would almost assuredly demand changes to that warhead,[*] which could introduce considerable uncertainty if there are no nuclear tests.

If serious deterioration is observed among a particular type of warhead in stockpile, the most likely response during a ban on nuclear testing would be to retrofit the stockpile by producing a new version of the same warhead. However, the weapon managers would probably elect to make some changes to avoid early reappearance of the same deterioration. No doubt they would make as minor changes as possible, since any change will introduce some uncertainty. Weapon-design experts would be called on to evaluate the proposed changes to determine their effect on warhead performance. Presumably, the changes would be limited to ones that the experts certify to have almost zero effect, but such certification is unlikely to be possible without some accompanying uncertainty.

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[*] If weapon engineers are to package a nuclear warhead into a new environment, such as a different carrier vehicle, they usually need to make changes to mounting structures, which can affect weapon operation. They also usually need to alter the warhead interior if it has to withstand any increase in the harshness of the warhead environment, such as higher g-loads (accelerations), higher or lower temperatures, or more-intense vibrations.

## 4. SOME DIFFICULTIES IN REBUILDING WEAPONS

Even if the responsible weapon organizations decide to produce duplicate warheads without any changes, they are likely to find that impossible. Various difficulties are likely to arise in attempting to produce new examples of an old weapon design. One probable difficulty is that complete-enough documentation of the earlier production will not be available. For example, some materials may not be characterized adequately. Material properties can depend on minor impurities and on details of the past processing of the material. For many materials, there may not be sufficient documentation of the processing that their properties can be closely reproduced.

It might be said that one need not describe the material itself completely; that, instead, one need describe only its required performance. However, it is probably not feasible to do that in useful terms. The performance required is, of course, that which would lead to proper overall nuclear operation of the weapon, which can be confirmed only by nuclear test. Measurements in the laboratory of partial, non-nuclear phases of a weapon's operation cannot go far in confirming correct overall performance.

Another possible difficulty in reproducing weapons comes from the fact that proprietary commercial products may be used in their production. The original production may have used one particular batch or formulation of a commercial product, and that formulation may no longer be available after many years. For various reasons, the specifications of commercial products change with time.

Still another possible difficulty is that certain materials may no longer be available because their handling or production is impractical under new OSHA rules. Some materials in weapons are potentially carcinogenic, others are toxic. Some have become subject to tighter and tighter controls, with their continued practical availability becoming questionable.

In addition to problems in reproducing materials, there are other problems in replicating components. Some components represent subtle fabrication technologies that were put aside years ago. To reproduce them now could require the reinvention of an old, outmoded technology. There would be great impetus to go to new, "superior" components, instead of attempting to reproduce old, outdated components.

## 5. UNCERTAINTIES WITHOUT NUCLEAR TESTS

All of these difficulties in replication mean that there are likely to be a variety of subtle, poorly known differences and perhaps some clear, intentional differences between old and new versions of a given weapon type. If a nuclear test of the new version is not possible, there can be serious uncertainty about its performance, including in some instances the possibility of its giving no appreciable yield.

Some proponents of a freeze would argue that such uncertainty would be acceptable, if not actually desirable. They presume that the Soviets would be subject to similar uncertainties about Soviet weapons. Freeze advocates argue that, with uncertainties in the performance of its weapons, each nation would be less likely to launch a first strike. In addition, some argue that if the U.S. were uncertain that U.S. weapons would operate successfully then assuredly the Soviets would also be uncertain about U.S. weapons. Not knowing definitely that U.S. weapons would not operate adequately, the Soviets would still be deterred.

These arguments, as presented, ignore various possible dangerous situations that could arise in place of the assumed safe symmetry. It may be that uncertainties would develop much earlier and more extensively with the U.S. weapons than with the Soviet weapons. In some circumstances, there may come to be clear evidence that certain U.S. weapons will not operate correctly, evidence that with time would become known to the Soviets.

While this paper will not consider the difficulties of verifying Soviet adherence to a freeze, it can be noted that the Soviets would be able to cheat in many ways, including the clandestine testing of their nuclear weapons. For example, past U.S. studies indicate that it would be feasible for the Soviets to test in space, up to very high yields, without detection, and it is conceivable that the Soviet Union has already confirmed that feasibility by conducting such tests. Nuclear tests by the Soviets and other possible asymmetries in observance of a freeze could allow the Soviets to retain full confidence in their stockpile while the reliability of the U.S. stockpile degenerated.

## IV. SOME PAST EXAMPLES OF STOCKPILE PROBLEMS

### 1. INTRODUCTION

The sections above note, in general terms, difficulties that can occur with nuclear weapons in the U.S. stockpile. Here, we review some specific past instances of stockpile problems. Our choice of illustrative examples has been limited by security considerations, and in the discussion below, we have had to avoid various items of classified information. Nevertheless, the information that can be presented can provide some lessons. For the first examples, we consider the nuclear warheads of the Fleet Ballistic Missile System (FBM), which have had a series of problems in the past.

Freeze advocates often stress the importance of the U.S. ballistic missile submarines, which are presented as being, at present, an assuredly invulnerable and reliable force--a force that would help make a nuclear freeze advantageous and safe for the U.S. In actuality, at times in the past the warheads for a large part of the U.S. FBM force have been found to be badly deteriorated. At different times, a large fraction of the warheads either obviously or potentially would not work; they were obvious or potential duds. Under the restrictions of a nuclear freeze, as proposed, these situations would have become desperate, because there would have been no means to rehabilitate the FBM force.

### 2. PROBLEMS WITH THE FIRST POLARIS WARHEAD

Some early difficulties occurred with the first Polaris warhead, the W47, now retired. In scheduled surveillance of W47 warheads in stockpile in December 1961, weapon engineers observed that significant corrosion had occurred in the fissile material of the weapon. This observation and subsequent inspection of additional W47 warheads indicated a possible problem with the yields of the stockpile weapons. There was the possibility that some weapons would give only a trivial fraction of their rated yield.

To obtain a dependable estimate of the resulting stockpile capability, the Atomic Energy Commission (AEC) conducted an underground nuclear test in Nevada. The test device was a modified W47 with man-made alterations of the fissile material to represent an extreme example of the corrosion that had been observed. The weapon scientists measured the yield to be somewhat low but still in an acceptable range. This satisfactory test result restored confidence in the W47 stockpile and permitted a limited, non-urgent retrofit program.

In the retrofitting, weapon engineers inspected each warhead by means of radiographs at a convenient time in the Polaris operations schedule. As a result, the AEC replaced 20 percent of the W47 warheads in stockpile with new production and made a slight design change in all the W47 warheads to prevent further similar corrosion.

In this instance of deterioration, the capability to conduct a nuclear test allowed the weapon scientists to respond in a moderate manner. Without a test, it could have been argued that all the weapons would be duds, and seemingly there would have been a need for an urgent rebuilding of all the W47s. A test allowed a less urgent, far more limited response.

A later, more difficult, problem with the Polaris W47 warhead grew out of certain earlier restrictions on nuclear testing. The weapon was put into stockpile during the nuclear-test moratorium of 1958-1961, without having had enough tests to fully resolve certain design problems. The particular troubles that we recount here eventually had to be cured by further nuclear tests.

Nuclear tests conducted shortly before the 1958-1961 moratorium were insufficient to provide an inherently one-point-safe* warhead in the Polaris Mk 1 reentry body. The situation arose because of a surprise result in a nuclear one-point-safety test of the W47 just before the moratorium. Instead of giving negligible yield, the test gave about one hundred tons yield. To counter this safety problem, the Livermore warhead developers provided a mechanical one-point-safety arrangement. Production of the W47Y1 warhead with this mechanical safing system began in May 1960.

During surveillance sampling of the W47 stockpile in 1963 (after the end of the moratorium), weapon engineers discovered in some sample weapons that the mechanical system did not fully complete its arming operation; this lack of complete arming would result in a dud weapon. The engineers attributed this failure to a growth in friction caused by some chemical reactions on the surfaces of components, to some crimping of one component during production, and to marginal power in the driving motor. The engineers were able to resolve this early problem with the safing mechanism by radiographing the W47 stockpile for evidence of crimping and by installing a more powerful motor. This was an example of a stockpile problem where the cure did not require nuclear test. However, as matters turned out, the cure was not effective against certain later instances of deterioration.

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* A nuclear weapon that is "one-point-safe" has a negligible probability of giving any appreciable nuclear yield if detonation is initiated at any one point in its high explosive system. (A one-point detonation is to be contrasted with correct, intentional detonation initiated by means of the firing set.)

Beginning in February 1963, a new version of the W47 began to enter stockpile, supplementing the old version, which remained in stockpile. The new version, the W47Y2 Mod 2, had the same mechanical safing system, but the warhead yield was higher, and the character of some of the fissile material was changed. In August 1965, in the first stockpile-surveillance (non-nuclear) test of the arming operation in the new-version warhead, the mechanical safing system operated only halfway, which would have dudded the weapon. This failure appeared exceptional, because in further tests both the old and new versions operated successfully. Nevertheless, concern remained when, even after a year of investigation, there was no agreed-upon explanation of the observed failure. This concern proved justified when further tests of the mechanical safing system in late 1966 resulted in additional failures with the new-version warhead.

From the time of the first failure in 1965 until early 1967, the weapon scientists concentrated great attention on assessing the Polaris warhead problem and finding a reasonable explanation and cure. They were unable to find a clear, full explanation. (There is still no completely satisfactory explanation.) Friction appeared to increase in the safing system as it aged, with more-rapid increase in the new-version warhead but with evidence that the old version would eventually also show failures.

At the time of this stockpile problem, three quarters of the W47 warheads were the new version. The observed failure rate was about three-out-of-four for the new version and, at that time, zero for the old version. Based on these observations, the overall failure rate for W47 warheads would have been about 50 percent. This rate would no doubt have become worse with time, possibly approaching 100 percent, with failures in the safing systems of even the old-version warheads.

Proposed engineering fixes were questionable. For example, there appeared to be no compatible lubricant that could be added to improve operation. Tests of proposed "improvements" also showed failures. Because of the on-going engineering difficulties, the weapon scientists sought a solution by means of nuclear tests. They first tested the new version for inherent one-point safety, without the mechanical safing system. A yield of about one hundred tons showed that, indeed, even the new version of the W47 was not inherently one-point safe.

Earlier, a nuclear test of a different, but similar, warhead had shown that warhead to be inherently one-point safe. The Livermore designers proposed to modify the W47 to give it certain features of the other type warhead. This they were able to do when new nuclear tests showed that the redesigned W47 without mechanical safing would be both one-point safe and capable of proper full-yield operation. The AEC proceeded to rebuild the entire W47 stockpile, converting all warheads to the revised version, W47Y2 Mod 3, by late 1967.

If the above problems with corrosion and with operation of the mechanical safing system had been discovered under the conditions of the proposed freeze, they could not have been solved while the freeze continued. The weapon scientists would not have been able to conduct a nuclear test to assess the effects of the observed corrosion in the fissile material; they would not have been able to conduct a nuclear test to evaluate their proposed solution to the problems with the mechanical safing system; and they would not have been permitted to rebuild the warheads.

It is to be noted that the freeze would have presented a still further impediment to the solution: without production of reserve nuclear material, the W47 could not have been converted to the Mod 3 design. That design version required the addition of more weapon-grade plutonium, the production of which would be banned under the freeze.

## 3. PROBLEMS WITH THE SECOND POLARIS WARHEAD

The precarious circumstances described for the Polaris W47 have not been the only difficulties with warheads for the Fleet Ballistic Missile System, and further difficulties have not been confined to the distant past. For example, during the 1970s, there were problems with corrosion in the W58 warhead for the later Polaris Mk2 reentry body. The AEC (later ERDA) and the Navy were able to counter these problems by certain minor changes to the warheads at Navy maintenance facilities, without any further nuclear tests being required or any major rebuilding.

## 4. PROBLEMS WITH THE FIRST POSEIDON WARHEAD

More recently, there were problems with the warhead for the Poseidon missile that were solved by a major rebuilding of the entire Poseidon stockpile, thousands of warheads. The warheads in trouble were the W68 warheads developed by the Lawrence Livermore National Laboratory (LLNL) for the Mk3 reentry bodies carried by the Poseidon C-3 missile.

The AEC began production of the W68 in 1970 and ended its original production in 1975. As we noted earlier, weapon scientists closely monitor the health of weapons entering and residing in stockpile. Over a seven-year period, as part of the stockpile-reliability program, Livermore scientists dismantled and evaluated portions of about one hundred W68 warheads. The weapon scientists found that the mechanical properties of the high explosive in the warhead degraded with time and that the high explosive began to give off a distinct odor, indicating some chemical change. Effluents from the high explosive interacted with other materials: the mechanical properties of a plastic component near the high explosive changed, and a uranium-alloy component close to the high explosive developed corrosion spots. These changes alone would not have caused the warhead to fail, but there was another associated change that did become a concern: effluents from the high explosive interacted with the adiprene adhesive in the detonators, causing it to soften. The Livermore scientists feared that products from this reaction could interact with the detonator bridgewire and eventually cause the detonator to fail.

In the time period 1977-1979, Livermore, in conjunction with ERDA (later DoE) and the Navy, evaluated the W68 situation more fully and considered possible remedies. Early in the development program for the W68 there had been two candidate high explosives for the weapon; these were LX-09, which was adopted, and LX-10. LLNL had fired two successful W68 development tests with LX-10, and the high explosive had performed adequately. Even after eliminating LX-10 from the W68 program, the Livermore scientists had continued to develop and evaluate it. By the late 1970s, the scientists were confident that LX-10 was free of the problems that were then appearing with the LX-09.

In 1979, on LLNL's recommendation, the DoE and DOD agreed to a complete time-phased retrofit of the W68 stockpile. The DoE weapons-production complex rebuilt all the W68 weapons, a few thousand, replacing the LX-09 with LX-10.

On the basis of the earlier nuclear tests, LLNL was confident of the reliability of the modified warheads, and the Laboratory did not require a new nuclear test. However, as a "final development test," LLNL did test the W68 again after the retrofit. In the test, LLNL used a weapon that was in many ways at the edge of acceptable tolerances and that had one limited-life component with an age that was over that of any to be used in stockpile. This extreme test device performed successfully, confirming the Laboratory's confidence.

The above examples of stockpile problems involved some of the most important strategic military systems of the U.S. The Polaris system and its successors, the Poseidon system and the Trident system, have constituted what arms-control experts consider the most crucial unit of the U.S. strategic triad. This sea-based component, which complements the land-based-ICBM and strategic-aircraft components of the triad, has been considered the least vulnerable unit of the three, hence the most survivable strategic force. However, as the above examples indicate, this force is susceptible to possible disablement under the proposed conditions of a freeze.

## 5. PROBLEMS WITH A MINUTEMAN WARHEAD

Difficulties do not arise only with the strategic warheads that are carried in the sea-based portion of the U.S. strategic triad. Problems have also occurred with the warheads for the land-based ICBMs. For example, in late 1963 the AEC had to rebuild all the W56 warheads of the Minuteman ICBM force.

The W56 warhead, like the Polaris W47 warhead, developed problems in stockpile with a mechanical component associated with arming operations. The weapon engineers discovered the W56 problems sooner and were able to resolve them more easily and quickly than was possible with the mechanical problems of Polaris.

LLNL developed the W56 warhead for the Minuteman MkII reentry vehicle in large part during the 1958-1961 test moratorium, when the Laboratory could not test the nuclear device. For certain reasons related to the inability to test, LLNL provided a mechanical arming arrangement as part of the basic nuclear structure.

In 1962, shortly after the end of the moratorium, LLNL successfully conducted nuclear tests of the W56 developmental design with its mechanical arming component, and the first production unit entered stockpile in March 1963. As part of a regular stockpile monitoring program, weapon engineers subjected certain W56 components to non-nuclear tests and found problems in stockpile with the mechanical arming component. In several tests, the arming mechanism did not fully complete its operation, presenting the possibility of duds. This was after the AEC had produced over one hundred warheads.

In a reasonably short time the weapons engineers were able to arrive at an acceptable redesign, one that had so little change that it did not require evaluation in a nuclear test. By the time the weapon engineers completed the redesign and the AEC could begin the retrofitting, over 160 weapons needed to be returned from stockpile to be rebuilt. That redesign has stood the test of time: further stockpile sampling has not shown any problems with the W56 arming mechanism.

### 6. PROBLEMS WITH THE W45 TACTICAL NUCLEAR WEAPON

Past instances of deterioration and other problems in the stockpile have not been limited to the warheads for strategic nuclear systems. Probably all types of nuclear warheads, including those for tactical weapon systems, have exhibited some degree of deterioration, leading in some instances to serious difficulties. Examples of problems with tactical nuclear weapons can be found in the history of the W45, which was the warhead for Little John, once a tactical missile of the U.S. Army. The W45 is still the warhead for both Terrier, a U.S. Navy surface-to-air missile, and the Army's and Marine Corps' atomic demolition munition (ADM).

In separate periods during the career of the W45, weapon engineers have discovered significant deterioration in the W45 stockpile. In surveillance of that stockpile during the early 1960s, weapon engineers found serious corrosion of the fissile material in W45 warheads. The corrosion was altering the geometry of the weapon enough to raise considerable question about the continued operability of the weapons. The AEC instituted a substantial review program in which weapon engineers inspected each W45 in stockpile and, using a criterion based on a related nuclear test, eliminated many of the corroded warheads from stockpile. For the units remaining in stockpile and for new production units, weapon scientists made certain design adjustments that have proved to provide adequate long-term protection against further similar corrosion in the W45.

In about the same time period, the engineers found dimensional changes in W45 weapons due to creep in the high explosive. To counter this problem, the AEC conducted a retrofit program in which LLNL engineers and scientists modified the warhead design, and the production plants rebuilt every W45 in stockpile.

Because the W45 was incorporated into three different weapon systems, and because individual systems needed more than one yield option, there were various yield versions of the W45. Early in the career of the W45, LLNL tested it under circumstances that were similar to those of an earlier test but with certain small changes that occur with aging in stockpile. The result was a rude surprise: the test device gave only about half its rated yield.

Because of this unexpected result and because of the design changes in the W45 retrofit programs mentioned earlier, LLNL tested the W45 in a series of five underground nuclear events in the mid 1960s. It was only on the basis of actual tests that the AEC and the military services could have confidence in the performances of the various yield versions at different stockpile ages.

## 7. PROBLEM WITH THE SERGEANT W52 HIGH EXPLOSIVE

The W52 was a thermonuclear warhead for the Army's now-retired Sergeant surface-to-surface tactical ballistic missile. The warhead design was being readied for production when two fatal accidents occurred in 1959 at what is now the Los Alamos National Laboratory (LANL), killing a total of four people. Both accidents involved large pieces of high explosive of the type to be in the W52. The two explosions revealed an unexpected susceptibility to accidental detonation of large pieces of that particular high explosive.

The pieces of high explosive to go into the W52 were also large, like the pieces in the accidents. For reasons of safety, especially during production, Los Alamos decided to change the HE system in the W52 to a less-sensitive high explosive, which was also somewhat less energetic. The Laboratory staff made this decision during the nuclear-test moratorium, 1958-1961, when they could not test the new design in a nuclear event. The weapon scientists based the redesign on non-nuclear hydrodynamic (high explosive) tests in the laboratory and on the results of calculations with computer programs. They had high confidence in the revised warhead, despite the lack of a new nuclear proof test.

After U.S. nuclear testing resumed in late 1961, Los Alamos gave higher priority to other test objectives than to a test of W52. This in part was because of the high confidence that the Laboratory had in the W52 redesign, which began to enter stockpile in April 1962. After more than a year of tests of other nuclear devices, LANL in early 1963 tested a partial-yield version of the W52. Proper performance of the partial-yield device would indicate, but not prove, proper performance of the full-yield weapon. On the other hand, poor performance of the test device would show that the full-yield design would not perform adequately. The result was calamitous: the test device gave only a small fraction of its expected yield. From the results of the nuclear test it was apparent that instead of the Sergeant missile system having its rated yield, its nuclear explosive energy would be only about one percent of that value, and the system would be militarily useless.

To restore the Sergeant system to its previously rated yield, Los Alamos scientists made a rapid redesign and added substantially to the content of special nuclear material. Within three months after the surprise test failure, Los

Alamos scientists tested the revised design, again in a partial-yield version. This time the nuclear test result was satisfactory, and the AEC replaced the W52 stockpile with the new design.

The problems with the Sergeant nuclear warhead were a severe example of potential difficulties with the stockpile if nuclear tests are not permitted. Before the corrective actions that resulted from the nuclear-test failure, every Sergeant nuclear missile was without any effective capability. Without the nuclear test, this ineffective version of the Sergeant force would have grown in number and remained deployed for years. The difficulties with the W52 warhead provide a dramatic illustration of the limitations of non-nuclear experiments and computer programs in the evaluation of even moderate changes in nuclear warhead designs.

# V. CONCLUSIONS

## 1. INTRODUCTION

The past examples noted above of serious problems with nuclear weapons in the U.S. stockpile point up some of the basic deficiencies of the proposed nuclear freeze. Each of the three particular proposed prohibitions discussed here presents immediate difficulties and potential serious risks. These difficulties cannot be regarded lightly, nor can they be considered desirable on the basis that they will occur for both the U.S. and the Soviet Union. Acceptance of the prohibitions leaves too much to happenstance and to unknown characteristics of the weapons of both nations. The extent of possible asymmetries between the U.S. nuclear weapon program and that of the Soviet Union is not definitely known to U.S. intelligence organizations. For example, the U.S. nuclear weapon systems may be far more susceptible to difficulties than are Soviet systems.

The occurrence of stockpile problems is to a large extent a matter of unknown probabilities; specific examples cannot be foreseen. For the U.S. to agree to do away with the means to respond to stockpile problems is to take the risk that the U.S. by chance will become far more weakened by the proposed prohibitions than will the Soviets. Beyond possible asymmetries that may result by happenstance or from basic differences in U.S. and Soviet weapons, there are definite possibilities of asymmetry by cheating. If in secrecy the Soviets violate the agreed prohibitions, they might maintain their weapons in known reliable working order while the U.S. weapons deteriorated, possibly in dramatic ways that become known to Soviet intelligence as well as to the U.S. military. The following sections briefly review the three particular proposed prohibitions addressed by this paper and again note the consequent difficulties.

## 2. FREEZE ON PRODUCTION OF NUCLEAR WEAPON MATERIALS

A prohibition against production of nuclear material for weapons would present severe problems for the U.S. For one, the U.S. needs to be able to operate production reactors to produce the tritium required to keep its weapons operable. Some freeze proponents have made note of this problem. *Call to Halt the Nuclear Arms Race* calls for a halt only to the "production of fissionable material (enriched uranium and plutonium) for weapon purposes." Randall Forsberg in her 1982 *Scientific American* article notes the need to replace tritium components in weapons and states, "This implies that the freeze should allow the operation of tritium-component assembly facilities and the running of perhaps one military nuclear reactor to produce tritium."

The U.S. also needs to maintain a reserve of weapon-grade plutonium. At the very least, this is necessary to permit the rebuilding of nuclear weapons that may require an increase in plutonium-content to correct some problem. The U.S. must operate uranium-isotope separation plants to produce weapon-grade uranium, which is required to fuel the ship-propulsion reactors of the U.S. Navy, including those of the Poseidon and Trident submarines. In addition, if development of breeder reactors is to continue in the U.S. and in the Soviet Union, both nations will need to be able to reprocess reactor spent fuel to separate plutonium. This plutonium, which would be used to manufacture fuel elements for use in breeder reactors, would not be weapon grade, but it would still be usable as the nuclear material in certain types of nuclear weapons.

Some freeze advocates have noted that it can be difficult to monitor any agreed level of production other than a zero level. However, zero levels of production of nuclear materials are out of the question, because of the requirements noted above. One cannot imagine the Soviet Union or other nations agreeing not to refuel nuclear submarines or not to reprocess reactor fuel and, hence, not to operate breeder reactors.

## 3. FREEZE ON PRODUCTION OF NUCLEAR WEAPONS

A prohibition against the fabrication of nuclear weapons would place unacceptable constraints on the U.S. There would then be no way to respond effectively to deterioration when it is observed in the nuclear stockpile. Again, some freeze advocates have argued that it is important that no nuclear weapon production be permitted. They note that a low level of production would be more difficult to monitor than zero production. Under the proposed freeze there would be no weapon-fabrication facility in operation and, in some proposals, even no weapon-fabrication facility capable of operation.

Such a prohibition of production goes directly against the needs of the U.S. to keep its nuclear weapon stockpile in operable condition and, hence, to maintain deterrence. Even for effective stockpile monitoring the U.S. needs fabrication-type facilities, since stockpile sampling requires carefully controlled machining to disassemble weapons and requires elaborate inspection and gauging equipment.

The U.S. needs to operate weapon-fabrication facilities to rebuild weapon systems that have deteriorated. To keep from revealing serious military deficiencies, the U.S. needs to keep any serious deterioration secret, at least until it is corrected. For this reason and other reasons, the specific rebuilding itself needs to be kept secret, and the facilities, while in operation, cannot be subject to Soviet or other foreign inspection.

## 4. FREEZE ON TESTING OF NUCLEAR WEAPONS

A prohibition of tests of nuclear explosives also would seriously inhibit the U.S. in maintaining a reliable stockpile of nuclear weapons. In addition to other reasons for nuclear tests, the U.S. needs the option of nuclear tests to assess the effects of weapon deterioration that may be found. Tests can be needed to determine whether an urgent or moderate response is required and to evaluate possible responses. If the deterioration is serious, all weapons of the type involved may need to be rebuilt or to be replaced by a different type, both of which are likely to require some alterations of warhead design. To make the alterations with confidence, the weapon managers will likely need one or more nuclear tests of the altered warhead.

If the warhead requires replacement by a different type, the replacement warhead will need various certification tests in its new role. It will require at least non-nuclear operational tests in the environment of the carrier vehicle, which could mean developmental flight tests, which are also prohibited under most freeze proposals.

## 5. OVERALL CONCLUSION

Whatever the other difficulties of a "nuclear freeze," the proposed bans that we have discussed would present great risks to the U.S. Under such a freeze there would be no assurance that major nuclear weapon systems could be kept in working order. As in the past, serious difficulties with particular types of nuclear warheads could abruptly become apparent. With bans in effect on rebuilding and testing, the U.S. would have no effective means to rehabilitate the weapon systems.

Any nation faced with that situation would expend great efforts to keep the difficulties secret and would have almost irresistible incentive to violate the bans. While the U.S. would have great difficulty in maintaining the required secrecy and in violating the bans without being detected, there is strong reason to believe that the Soviets could do both. There would be a major asymmetry between the U.S. and the U.S.S.R in the risks involved in entering into such a freeze agreement. The U.S. needs to seek a more realistic, less simplistic, and less risky path to the reduction of tensions between the U.S. and the Soviet Union than the path offered by the freeze proposals.

# OVERSIGHT HEARINGS ON ARMS CONTROL AND DISARMAMENT ISSUES

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House of Representatives, Committee on Armed Services, Special Panel on Arms Control and Disarmament of the Procurement and Military Systems Subcommittee,

*Washington, DC, Friday, September 20, 1985.*

The subcommittee met, pursuant to call, at 10 a.m., in room 2118, Rayburn House Office Building, Hon. Beverly Byron (chairman of the special panel) presiding.

## STATEMENT OF HON. BEVERLY B. BYRON, A REPRESENTATIVE FROM MARYLAND, CHAIRMAN, SPECIAL PANEL ON ARMS CONTROL AND DISARMAMENT OF THE PROCUREMENT AND MILITARY NUCLEAR SYSTEMS SUBCOMMITTEE

Mrs. Byron. This morning the panel will complete this series of oversight hearings on arms control and disarmament issues. On completion of today's hearings, the panel will have received first hand information on the active and important arms control negotiations that have taken place this year. The panel plans to augment this information through on-site visits with the U.S. negotiating teams and discussions with the negotiators representing other participating countries.

The panel has also heard from Department of Defense and Department of Energy officials and technical experts on the military implications of existing arms control agreements and the possible effects that proposed agreements might have on U.S. national security and military force structure.

The Chair has received several inquiries concerning the purposes of these hearings and whether additional hearings will be scheduled later this year. In response the the first question, Rule X, clause 3(a), of the rules of the House states, in part:

> The Committee on Armed Services shall have the function of reviewing and studying on a continuing basis all laws, programs, and government activities dealing with or involving international arms control and disarmament.

The rules of the Committee on Armed Services delegated that responsibility to the Subcommittee on Procurement and Military Nuclear Systems. Chairman Stratton has appointed this panel to assist the subcommittee in these duties. The panel's report for the 98th Congress was submitted to the subcommittee on December 28, 1984 and is printed as H.A.S.C. Committee Print No. 23.

In response to the questions on additional hearings, it is the intention of the Chair to consult with the other members of the panel and to examine the schedules of the full committee and the subcommittee to determine whether there are other appropriate studies or technical issues that should be addressed. Any additional hearings will be announced by an appropriate press release, listed in the Daily Digest of the Congressional Record, and announced in the committee's weekly schedule of hearings. It is my feeling that we probably will have further hearings.

Our first witness today will be Dr. George C. Dacey, president, Sandia National Laboratories. Dr. Dacey will be followed by Mr. Roy Woodruff, Associate Director for Defense Systems at the Lawrence Livermore National Laboratory, and Mr. Robert N. Thorn, Deputy Director of the Los Alamos National Laboratory. I was interested to see this morning that Lawrence Livermore and Los Alamos still have a home. I understand that Mr. Thorn will be accompanied by Dr. Paul Robinson, Principal Associate Director for National Security Programs, at Los Alamos.

Following the testimony of the laboratory witnesses will be Mr. Thomas Clark, Manager of the Nevada Operations Office at the Department of Energy. Mr. Clark is directly responsible for operating the Department of Energy's Nevada Test Site which represents the only weapons test facility available to the United States. The final witness will be Mr. Ron Ewing, Director of the Systems and Technologies Division at the Department of Energy.

Because it will be necessary to complete this hearing by 12:30 p.m., today, I ask that the witnesses expedite their testimony consistent with a clear presentation; and without objection, all prepared statements may be inserted in the record as appropriate.

I welcome all of the witnesses to the panel and look forward to receiving your testimony.

Mrs. Holt, do you have a statement?

## STATEMENT OF HON. MARJORIE S. HOLT, A REPRESENTATIVE FROM MARYLAND, RANKING MINORITY MEMBER, SPECIAL PANEL ON ARMS CONTROL AND DISARMAMENT OF THE PROCUREMENT AND MILITARY NUCLEAR SYSTEMS SUBCOMMITTEE

Mrs. HOLT. Thank you, Madam Chairman.

I want to welcome the witnesses to the panel, Madam Chairman. Before I proceed, I want to say that I regret this will be Dr. Dacey's last appearance before us as President of the Sandia National Laboratories. I understand that he is retiring at the end of this month after a long and distinguished scientific career. The National Laboratories at Albuquerque and Livermore have been in excellent hands during your stewardship, Dr. Dacey. In addition, you have never hesitated to provide us with your honest opinions and views. We appreciate your appearance here today.

Madam Chairman, there are three issues that I hope that the witnesses will address today. First, it is claimed that a comprehensive test ban will stop the building of destabilizing systems. Is there a reverse side to this question? Wouldn't a comprehensive test ban also stop the building of more stabilizing systems, such as Midgetman, hardened satellites, and others?

Second, at what point would a CTB and the existing ABM Treaty stop research and development on defensive systems, including the SDI?

Another issue involves assertions that there is a difference of opinion between the Livermore National Laboratory and the Los Alamos National Laboratory with respect to our ability to verify the Threshold Test Ban Treaty or a comprehensive test ban treaty. We have the responsible people from each laboratory before us today and they should discuss any differences the two laboratories might have on the verification issue.

With respect to additional hearings, Madam Chairman, it might be appropriate for the panel to invite the several sponsors of House Joint Resolution 3 and H.R. 3100 to testify on the practical effects that those two measures would have on our defense posture if enacted.

Thank you.

Mrs. BYRON. Dr. Dacey, you may proceed.

## STATEMENT OF DR. GEORGE C. DACEY, PRESIDENT, SANDIA NATIONAL LABORATORIES

Dr. DACEY. Thank you, Mrs. Byron and Mrs. Holt, and thank you for those kind words about my service over the past several years.

For the record, I am making a slight correction. It is true that my successor has been named and will arrive at Sandia the first of the month. His name is Irwin Welber. He is a vice president of Bell Laboratories at the moment, a very good man, and I am sure will be a fine president of Sandia. However, we will overlap for about 3 months. I am going to stay there and help to get him started.

To begin with, I do have an official statement and I hope that it can be entered in the record. I will probably not repeat those things, but will try to amplify the statements that I made in there. I think it would be well, perhaps, to begin with a statement of the difference between the way testing affects Sandia and other laboratories. Sandia, as you know, is responsible for the nonnuclear, nonexplosive parts of weapons, and our concern, therefore, is not so much with the design of nuclear explosives, which you have heard and will hear about from our sister laboratories, but with the other components that make those explosives into an operating weapon which man can control: Its safety, terrorist immunity, fuzing, structural design—all those things.

In that respect testing is more important to us from the standpoint of our responsibility, in trusting those components at full nuclear yield to assure that they will survive the environment in which they are intended to operate.

### TEST BAN

So our point of view is somewhat different from the other laboratories but, nevertheless, I think our conclusions are very much the same; namely, that a test ban would be a great impediment to further progress in our job as well as in the job of the other laboratories.

Let me amplify on that. I think that one way of looking at this question is to examine what would have happened if we had had a test ban or a freeze in the past, and what kind of things we can extrapolate from that into the effects in the future. While the exact numbers are classified, it has been declassified, as you know, that the number of nuclear weapons in the stockpile has been going down steadily from the sixties—not up, as is sometimes represented. The yield has also been going down steadily, not up, as has been sometimes represented; and that has been a direct result of the development of new kinds of weapons that can do their job with smaller yields, greater accuracy, and with smaller and fewer collateral side effects.

I believe that most of the people who favor a freeze or a test ban would applaud those changes in the nature of the stockpile and, therefore, I conclude that had we had a test ban or a freeze at any time in the past, the existing stockpile would be less desirable, less stabilizing, less under control, than it now is.

If one looks to the future, it seems to me that one can draw some very similar conclusions. The kinds of technology that are currently being developed center in large measure around the revolution of electronics, in microelectronics, the whole chip revolution, and the use of artificial intelligence. All of these things make possible a new generation of weapons which, if we choose, can be more stabilizing, smaller, more accurate, and have less collateral damage than the ones that we have today.

Now, the whole purpose, as we all know, of the nuclear stockpile is to deter others from beginning a nuclear war, and the question, therefore, must be "What kind of stockpile does it take to be an adequate deterrent?" Surely you cannot deter an enemy who has a very modern stockpile with one that is antique. Surely you cannot convince a potential adversary that you know what you are doing if in fact you haven't been working in a field for many years. I would be very loathe to leave to my grandchildren the defense of our country with 50-year-old weapons that were in the care of people who knew nothing about how they operated.

So a continuing program of R&D in nuclear weaponry is, I fear, forced upon us by the fact that we do live in the world with potential adversaries who do have nuclear weapons, and as long as that situation exists, there seems very little possibility to me that we can improve our defense by stopping our work in this area.

I would like to quote from the final paragraph of the testimony which I have entered. It says something which I feel very deeply. It says, and I quote:

> There was a time early in the nuclear age, when the restriction that a test ban would have placed on nuclear weapon R&D could have been an important influence on the nuclear arms race. While for many it remains a lost opportunity or a personal commitment, it could well be more of a detriment than a benefit to ensuring peace and stability for the future. We cannot freeze the situation as it is today and expect inaction in technology to produce action in diplomacy. We must call both the political and technical communities to action on all fronts to deal with the serious issue of nuclear weapons. In this action, a directed, but vigorous and unfettered R&D Community remains, in my opinion, essential.

Thank you.

## PREPARED STATEMENT OF DR. GEORGE C. DACEY, PRESIDENT, SANDIA NATIONAL LABORATORIES—SEPTEMBER 20, 1985

Representative Byron, members of the panel, distinguished guests. I am pleased to be able to provide you with some comments on the effect of an extended moratorium on nuclear testing or a comprehensive test ban. Sandia Laboratories has responsibility for research and development on those elements of nuclear weapons outside of the nuclear explosive itself. Our R&D responsibilities include weapon safety, command and control, fuzing and firing, structural design, and the attendant testing and evaluation programs to ensure that the stockpile is safe, reliable, and effective. Our principle involvement with nuclear testing is in investigating the effect of a nuclear radiation environment on those components for which we are responsible.

The most direct effect of a cessation of nuclear testing would be on our sister laboratories, the Los Alamos and Lawrence Livermore National Laboratories, who are responsible for the design of the nuclear explosive. Sandia's work in nuclear weapon effects would also be directly affected by a cessation, although some of the work could continue through the use of simulation machines. We would see a longterm indirect impact on the laboratory from the restriction on research and development which would result at LANL and LLNL. This longterm impact is the more important since it has the potential to seriously change the process by which we have changed the nuclear weapon stockpile. That process has been guided by a DOD/DOE structure that has responded to the evolving threat in a way which is intended to maximize our ability to deter nuclear war, eliminate the possibility of an accident or unauthorized access to a weapon, and to minimize the collateral effects of nuclear weapons. In the last twenty years this R&D process has not only provided an effective deterrent, but has also significantly reduced the total yield of the stockpile and established extremely high levels of reliability and safety. It is not clear whether a CTB twenty years ago would have produced a smaller or less destructive stockpile today, but it could well have produced a less safe and reliable one.

I believe that this observation leads to a key point. Restrictions on R&D (and that is what a CTB is) always seem compelling since they appear to go to the "source" of the problem of nuclear weapons. In reality, it seems to me that the basic problem is the deployed weapons themselves—their numbers, locations, and associated doctrine. A more logical approach would be to focus on controlling the fruits of the R&D process, rather than the problems itself. That process can be, and has been, directed towards stabilizing developments in command and control, safety, reliability, and reduced collateral effects. We should not restrict the tools by which we can do R&D when our desire is to direct the process into areas which reduce the likelihood of nuclear war or accident and the consequences, should either occur.

I have another concern regarding a CTB or extended moratorium, and that has to do with verification. At Sandia and the other weapons laboratories, we have had a long history of R&D on monitoring technologies for test restrictions. That work has led to a variety of satellite and ground-based systems, many of which have been used for monitoring existing test restrictions. That work continues today with nearly two hundred technical staff at Sandia committed to verification technology. This long experience with monitoring of nuclear testing causes me to have some concern with an absolute prohibition.

The principal verification concern in a CTB or moratorium is the monitoring of seismic events to detect an illicit underground detonation. There has been an ongoing debate about whether we can or cannot detect any "significant" cheating by the Soviet Union. We simply cannot guarantee that we will be able to detect nuclear tests that could have a significant military value to the Soviets. This is true for two reasons, one having to do with the military significance of even a few small tests. Let me expand on these points.

The detection and identification of seismic events is a statistical process which is influenced by the nature and location of the instruments used to collect the signals. We envision no future development that will change this fact. In effect then, monitoring of any underground test restriction will involve some probability that an illicit test will be undetected or, if detected, will not be clearly identified as a nuclear event. Similarly, there will also be some probability that a natural event may appear to be a nuclear event. We can see this fundamental statistical process in play already in the threshold test restriction. As the nuclear yields of interest become smaller, this problem only becomes worse and, even with improved detection systems, we must face the inevitability of uncertainty regarding Soviet compliance.

The DOE weapon laboratories are seeking new approaches that may improve sensitivity. At Sandia we are also engaged in a continuing program to increase the sensitivity of our instruments, improve their reliability, and enable them to function unattended for long periods of time. There are also detailed studies underway to improve our interpretative capabilities for data collected from these systems. Progress is being made; however, there will be no point at which technology and science can remove the residual uncertainty that must accompany any underground test restriction. No single method of detection can provide convincing evidence of a violation. This country must realize that we will regularly be faced with the ambiguous events and the possibility of Soviet noncompliance, and the lower the yield of test restriction, the more uncertainty.

Verification is a political issue, and technical uncertainty will be viewed through a political lens. A central element of the political evaluation will be the risk to our national security of some levels of cheating and on that subject I am sure you will see a variety of opinions. My own feeling is that there are two levels of risk. The first has to do with the technical value of some or a few tests at relatively small yields. I believe that LANL and LLNL can supply you with a good understanding of the importance to the nuclear designer of such tests. I would only add that such tests can provide a nuclear effects environment which cannot be simulated in any other way, and which may prove essential in the design of survivable strategic defensive systems and, for that matter, any systems which we will have space.

The second level of risk in Soviet compliance relates to the influence on the nuclear weapons program of even a small number of tests of relatively insignificant yield. The R&D associated with designing and conducting the tests, and analyzing with the data can have powerful positive benefit in keeping a cadre of nuclear weapons designers current in the technology and involved intellectually. We know that the Soviet system can dictate the level of resources allocated to a military area; a very low level of nuclear testing can provide the stimulus for creativity which they cannot dictate. We can dictate neither. I feel that the constraints of a CTB will eventually have a serious and inequitable impact on quality and quantity in U.S. nuclear weapon R&D. Some people may feel that this is actually a desired end and may disagree regarding Soviet future behavior. I feel that the risk in terms of cost capability to improve safety, reliability, and stability, cannot be confidentially offset by the uncertain benefits resulting from a CTB.

There was a time early in the nuclear age, when the restriction that a test can would have been placed on nuclear weapon R&D could have been an important influence on the nuclear arms race. While for many it remains a lost opportunity or a personal commitment, it could well be more of a detriment than a benefit to ensuring peace and stability for the future. We cannot freeze the situation as it is today and expect inaction in technology to produce action in diplomacy. We must call both the political and technical communities to action on all fronts to deal with the serious issue of nuclear weapons. In this action, a directed, but vigorous and unfettered R&D community remains, in my opinion, essential. Thank you.

Mrs. BYRON. Thank you very much.

Let me start with a couple of questions. How do you respond to the argument that there is more to be gained by ratifying this comprehensive test ban than holding it forever in limbo? I think we have looked at the thinking that without a comprehensive test ban the Soviets will then proceed to ignore the threshold limits, and where do we go from there?

Dr. DACEY. Yes; I think one must draw a distinction between being generally in favor of some sort of ban or other on the one hand, and the specific conditions of a ban on the other hand. A comprehensive test ban, before it could be acceptable to me, would have to involve the ability to verify it. We would have to know that the ban was absolute and uniform on both sides, and it is the opinion of the experts at Sandia—and in fact I think most experts in the field—that an absolutely guaranteed verification system is not technically feasible.

One can do better or worse jobs, but eliminating all risk of cheating on a ban seems to me impossible from a technical point of view, and therefore, the question of whether it would be more stabilizing or less stabilizing, it seems to me, must be addressed; because if, in fact, you aren't absolutely certain that the other person isn't cheating and you propose not to cheat, then the logical reaction is to build, not a smaller stockpile, but an even larger one to take care of contingencies that you don't know about. So I think that the assumption that a test ban is somehow a good thing, leading to stability, is an untested and, in my view, untrue assumption.

I would say further, that this class of approach to a world problem which no one doubts exists, is wrong—is going at it, you might say, at the wrong end of the stick. To try to reduce the risk of existing weapons, the use of weapons, the horrors of war, by attacking the earliest theoretical thinking about the problem, it seems to me is a very indirect way of going about it.

And I might say this: If in fact, one could conclude a test ban that had an element of trust in it, which had both signators of the treaty agreeing that in spite of these many unexplained events, they were in fact observing the ban, then that element of trust would be much more usefully applied to direct reductions in weapons, in my view. If the trust does not exist, then the ban won't work.

Mrs. **Byron**. Do you feel with regard to the verification issue—I don't think right now it isn't that we can't detect a nuclear explosion, it is really how we interpret the data and the interpretation of the data is a scientific problem, but it also is a political problem from that aspect.

Dr. **Dacey**. Yes; that is very true. Every year there are many hundreds, perhaps, of seismic events which, at least with the existing kinds of network, or networks one can imagine, without an agreement to put detectors on adversarial soil, are unable to detect the difference between a natural event and an intended nuclear event with a degree of confidence that would not raise the political question that you mentioned.

So that ultimately, if you have an item in dispute, it resolves itself as a political question. We would claim that this could be a nuclear event and they would claim no, it wasn't; and now you are in the political arena, not the technical arena.

Mrs. **Byron**. Mrs. Holt.

Mrs. **Holt**. I have no questions.

Mrs. **Byron**. Mr. Ray.

Mr. **Ray**. No questions.

Mrs. **Byron**. Mr. Stratton.

Mr. **Stratton**. No questions.

Mrs. **Byron**. Mr. Spratt.

Mr. **Spratt**. Thank you.

If we resolve the verification process by something including thorough on-site inspection, would a ban on comprehensive testing be worth pursuing?

Dr. **Dacey**. If you are asking my opinion in the matter, I believe it would not. Not because on site inspections wouldn't be of enormous help in the ability to detect cheating—they certainly would—but because the element of trust that is involved in the negotiation of such a treaty—of having foreign nationals on one another's soil, of participating jointly in a means of assuring that we weren't doing something that we were saying we weren't doing—that that trust could be better applied to a more direct approach to the problem, which is reduction of weapons.

I believe it would be wrong to try to limit R&D on either side over a long period of time, because it is my view that mankind can address its problems best if it knows the answers, or at least is trying to reach the most objective scientific knowledge about a situation, than if it keeps itself in intentional ignorance. I think that is a dangerous way to approach the problems of the world.

Mr. **Stratton**. Did you see the Op Ed piece by Senator Carl Levin in the Washington Post yesterday?

Dr. **Dacey**. No; I was in travel yesterday.

Mr. **Spratt**. Senator Levin came back from being an observer at the disarmament talks and the preliminaries to the nonproliferation negotiations, and he noted in the article that the preamble to the nonproliferation treaty calls for the United States and the U.S.S.R. to negotiate toward a ban on the testing of nuclear weapons. The text of the treaty itself calls for the United States to negotiate in good faith toward the reduction of nuclear weapons. But as he notes, that is judgmental.

The preamble in calling for the United States to negotiate with the Soviet Union is really a question of fact. It is a question of fact, whether or not we have sat down at the table and offered our position as to a comprehensive test ban. In other words, we have a risk here. He is saying, that the parties to the nonproliferation treaty who are forebearing now in the development or acquisition of their own nuclear weapons may cite our noncompliance with the treaty provisions as an excuse for their not acquiescing in the renewal of the treaty.

Do you think proliferation is something also that we need to be concerned about in the world today?

Dr. **Dacey**. Well, certainly I feel that proliferation is something we need to be concerned about, and the relationship between test bans and nonproliferation issues are in my view not as direct as perhaps Mr. Levin was indicating.

I would be the last person in the world to be against negotiating or against trying to find some sort of common ground for agreement between ourselves and the Soviets on almost any issue. Since the world has to live with the two superpowers and they have to live with one another, negotiating can't be bad. What is surprising I think was a personal doubt that those negotiations would in fact result in an agreement that would be in our national interest.

Mr. **Spratt**. What do you think would be a reasonable common ground that would allow for the sort of R&D that you think would permit us to continue the stabilizing developments and verification of our own stockpile, its utility?

Dr. **Dacey**. Well, we are living now with a test ban of sorts, not a comprehensive ban but a threshold test ban, and I believe that the technical situation between ourselves and the Soviets—the technical situation, not the deployed situation—has been relatively acceptable. We have done our research, they have done theirs. As far as I know, there have been no incidents stemming from the R&D which caused additional tension in the world. So I believe that we could negotiate an ongoing R&D program with the Russians that would be satisfactory to both of us.

Of course, their R&D would be held secret by them, and the same on our side, because, as I said earlier, it seems to me that anything that reaches a much more desirable status than the one we are now in, requires a degree of political amity, of trust, of agreement, between our two societies, which I simply don't see in view at the moment.

Mr. **Spratt**. Thank you.

Mrs. **Byron**. Mr. Klein, do you have any questions?

Mr. **Klein**. Have you had an opportunity to read the bill, H.R. 3100?

Dr. **Dacey**. Yes, sir, I have.

Mr. **Klein**. Do you have any particular comments on that bill?

Dr. **Dacey**. Well, it is very difficult for me to comment politely I suppose, because the bill seems to me to be an admixture of an attempt to solve a political problem by a broad, bilateral verifiable freeze on the one hand, and a set of what appear to be definitions and tight criteria on the other, and a detailed specification of the conditions under which an agreement could, should, or would be verified between ourselves and others, it seems to me is not something which the Congress can do.

This is a highly technical matter involving expertise on both sides and to try to specify those things in a short bill, it seems to me is very dangerous.

Mrs. **Byron**. Thank you very much, Dr. Dacey, I appreciate your testimony today and I am only sorry that it is going to be the last time that we will be having you testify before us. It has been a pleasure.

Dr. **Dacey**. Thank you, Mrs. Byron.

Mrs. **Byron**. Mr. Woodruff and Dr. Thorn.

## STATEMENT OF ROY WOODRUFF, ASSOCIATE DIRECTOR FOR DEFENSE SYSTEMS, LAWRENCE LIVERMORE NATIONAL LABORATORY, ACCOMPANIED BY PAUL ROBINSON, PRINCIPAL ASSOCIATE DIRECTOR FOR NATIONAL SECURITY PROGRAMS, LOS ALAMOS NATIONAL LABORATORY

Mr. **Woodruff**. Thank you, Madam Chairman.

I am certainly pleased to be here and have this opportunity to testify on the consequences of the nuclear test moratorium, which after all, actually occurred during 1958 to 1961. So in the language of physicists, which I am, we have some data. We know what the consequences of a period of the absence of testing had on the laboratories and on our ability to do the mission of the laboratories as far as nuclear weapon development is concerned.

I would like to put my remarks in the context of that experience, even though I wasn't there at the time, and I am sure that Dr. Thorn will elaborate, as he was there during that period, and can tell you exactly what the consequences were at Los Alamos Laboratory.

Before I begin on those specific remarks, I think it is pertinent to say a word or two about my background, because I have designed nuclear weapons for 10 years, and also spent 2 years of my career at Livermore doing the experimental physics and test part of the program. I bring that up because it is difficult for anyone to really fully appreciate the technical problems that nuclear weapons development present to the laboratories. It is much like trying to understand how you pilot a jet aircraft without actually being a pilot yourself.

I came to the Laboratory in 1968 because I thought there were important national security problems to be worked on and the Laboratory offered me an opportunity to contribute to the solutions of those problems. In that sense, I was doing applied physics, even though it was physics of nuclear weapons. I believe, as many of the witnesses that have been here before you in the last few days, and will appear after me today, have said, that the most significant impact of a moratorium or a comprehensive test ban on the ability to do national security work on nuclear weapons is, in fact, what it will have as a consequence to the people at these design laboratories.

## APPLIED SCIENTISTS

We are applied scientists. We came to the laboratories because we could do applied science, even though it was in the area of nuclear weapons and national security. As a key element of that, we have to be able to test and verify that our theories and computer simulations are actually going to perform in the way we intended. Because some of these designs are so complex, we break the design sequence into many stages and do many tests.

Frequently these Nevada tests result in surprises—sometimes rude surprises—showing how far off our theories really are. That is because this is a science that is difficult. We deal with temperatures of tens of millions of degrees, millions of miles an hour for the velocity, time scales that are measured in billionths of a second. We have to understand the conditions in exploding nuclear weapons in a fairly fundamental way to be able to predict accurately from either theory or computer simulation that we are going to have a military useful weapon at the end of our development process.

Scientists with the training and background necessary to be successful as nuclear weapons designers are very rare. You don't teach that in graduate schools. I am sure you are all aware that one of the more pressing problems on the national scene in general is the lack of graduates in the sciences and engineering disciplines. We take the best, the brightest, I hope—we think we do—and we train them for many years to be nuclear weapon designers.

That training, however, is applicable to many other areas of our technology. I am speaking of Livermore, because that is where I am from. We are in a very high technology region of the United States. We have Silicon Valley within commuting distances. In fact, in the Livermore Valley, we are finding many industrial parks building up that will be drawing staff members from our laboratory into an economically competitive environment.

I believe the most serious consequence of the absence of testing is that we send a message to the people that work in the laboratories that their work is perhaps unnecessary, and even worse, undesirable. These people have been trained over many years and are very qualified, and I believe they will immediately start seeking jobs in other parts of our society where their expertise is valued more highly.

That is the experience that many of the old hands at Livermore talk to me about in the context of what happened during the 1958 to 1961 period. Dr. Art Hudgins, who in fact hired me in his last year as a member of our Personnel Department in 1969, experienced this as the head of our personnel hiring activity from about 1955 to 1966 at Lawrence Livermore. He recollects that about 10 percent of our physicists actually left and the fact that the moratorium was only 3 years long was very fortunate. We had many that were right on the verge of leaving when the Soviet Union announced that they were breaking the moratorium. This really was unanticipated. They broke out with the largest test program in the history of their activities, and in the world. That then produced an environment that was again attractive to our staff and they, instead of leaving, stayed.

Insofar as what actually happened during the moratorium, both laboratories experienced problems with specific weapons that were introduced into the stockpile. I have in both my unclassified remarks and my classified appendix some specific examples, which were significant and serious. The W-52, which was a warhead that was designed at Los Alamos for the surface to surface missile—now retired—known as the Sergeant, had problems, problems serious enough that after the moratorim they had to be addressed with additional testing and new designs.

At Livermore we had problems with a low-yield weapon system called the W-45 that has many applications, including the Terrier missile and atomic demolition munitions. It had to be redesigned after the moratorium because we were overly optimistic with what our computer simulations were telling us in the absence of testing. We introduced a weapon into the stockpile that did not perform satisfactorily until we were able to go back and test it.

Those are the specifics, those are the facts, those are the things that actually occurred. I have outlined these in some detail in my written testimony for the record, and I think I have given you the two most salient examples.

Insofar as my personal views about a moratorium at this time, it has been 24 years since the moratorium, and computational and nonnuclear experimental capabilities have greatly improved. Even so, as Dr. Batzel, the laboratory director, testified earlier this week, we still encounter surprises when we have nuclear tests. Our ability to maintain confidence in the stockpile, and that it will function properly, is still limited. The bottom line is simply that the current stockpile requires testing if it is to remain reliable.

I personally regard this as a particularly inopportune time to consider a moratorium. Specifically addressing one of the questions that Mrs. Holt raised insofar as new weapons under development, the absence of testing would severely restrict those options that would be available to the military for our future stockpile. We are working on weapons that have lower yields and reduced collateral effects.

Certainly the small ICBM would be affected by the absence of testing, if we stop testing as of today. In particular, for example, the baseline warhead for this ICBM is the warhead that is being developed for MX. If you have basing options in the future that would provide for greater mobility for the small ICBM, you might want to change that baseline and design a warhead that had even further enhanced safety. That option would be precluded if we could not test.

In the area of the strategic defense initiative, certainly the scientifically significant breakthroughs in new weapon concepts, such as the x-ray laser or any nuclear directed energy weapon would be stopped in the absence of testing.

In addition, the effects of nuclear weapon tests on hardware that would be essential for the functioning of the strategic defense system would be very difficult to verify. This is called vulnerability and hardness testing in the language of the nuclear weapons community.

Finally, let's not forget asymmetry between the United States and the Soviet Union as far as ballistic missile defense is concerned. They have been operating, some say within the compliance boundaries of the treaty, and some say without, but they have been operating a ballistic missile system around Moscow since 1972. They have gained all the experience of that system, and they have made significant upgrades. We don't know what systems in detail are on their interceptor missile. We have evidence that suggests they have current modern nuclear warheads on those missiles. If they took those systems and deployed them on a much larger extent, in the absence of testing, we would be severely restricted relative to what their capability would be.

Those of us who followed the history of the moratorium and the debates on the nuclear test ban remember the statements of John Kennedy in 1962 that have been submitted by him for the record—I would like to do it as well. I think the words are so important to us in today's environment. I am quoting now from President Kennedy:

> We know enough about broken negotiations, secret preparations, and the advantages gained from a long test series never to offer again an uninspected moratorium. Some urge us to try it again, keeping our preparations to test in a constant state of readiness. But in actual practice, particularly in a society of free choice, we cannot keep top flight scientists concentrating on the preparation of an experiment which may or may not take place on an uncertain date in the future. Nor can large technical laboratories be kept fully alert on a standby basis waiting for some other nation to break an agreement. This is not merely difficult or inconvenient, we have explored this alternative thoroughly and found it impossible for execution.

In regard to the current moratorium that the Soviets have announced, I would simply recall what President Kennedy also said in 1961:

> The Soviet Union prepared to test while we were at the table negotiating with them. If they fooled us once, it is their fault, and if they fool us twice, it is our fault.

In closing, I am very concerned that a moratorium is just the first step toward a comprehensive test ban. As long as we must rely on nuclear weapons for our national security, we will need the capability to check their performance.

Thank you very much.

# THE NUCLEAR TEST MORATORIUM OF 1958-1961

## IMPACTS AND CONSEQUENCES

Roy D. Woodruff
Associate Director for Defense Systems

University of California
Lawrence Livermore National Laboratory

I appreciate the opportunity to testify concerning the nuclear test moratorium of 1958-1961, and to describe how that moratorium affected our capabilities in the weapons laboratories. Before specifically addressing the test moratorium of 1958-1961, permit me to make some general comments.

Before I became an administrator at the Lawrence Livermore National Laboratory, I designed nuclear weapons for over 10 years and was responsible for the experimental physics part of the nuclear test program for 2 years. I think this is significant because it is exceedingly difficult for anyone to fully appreciate the technical problems that nuclear weapon development and testing present to those responsible for these activities unless they have actually done this kind of work themselves; just as those of us who have never flown an airplane cannot easily comprehend the skills that the pilot of a jet aircraft must master in doing a safe and competent job.

I came to the Livermore Laboratory in 1968 because there were important national security problems to be worked on. The Laboratory offered me the opportunity to contribute to the solution of those problems while being involved in one of the most advanced and exciting environments available for doing applied physics research.

I believe one of the major difficulties we must address if this country enters once again into a moratorium is how the design Laboratories will continue to attract new staff and retain those key individuals who are responsible for the design and testing of nuclear weapons. For this reason I would like to briefly describe how a weapons designer goes about the development of a new concept for nuclear weapons.

We make heavy use of the large supercomputers at the Laboratory, using them to do hundreds, indeed thousands, of "experiments" to simulate how a particular weapon configuration might behave if it were actually exploded at the Nevada Test Site. After many iterations, we converge on what appears to be a successful design. But this is not a "real" design. Rather, it is the product of many assumptions about how material behaves at the extreme conditions experienced in a nuclear explosion: temperatures of ten million degrees, velocities of a million miles per hour, and time scales measured in billionths of seconds. These assumptions are often based on limited actual experimental data and on theoretical predictions that are difficult, if not impossible, to verify with anywhere near sufficient detail.

Applied physics means getting real results. So we go to Nevada, and test our "design." Sometimes, the design is indeed not real because it does not function in the test as the designer expected, and changes must be made in order to meet the requirements of the military, whether the Army, Navy, or Air Force. After more iterations on the computer to explain the results of the first test and to "normalize" the calculations, it is back to Nevada for a second test, and sometimes even a third, fourth or more tests. In many cases, we know in advance that many tests will be required before a final design can be achieved. Because some of these designs are so complex, we break the design sequence into stages and solve the physics problems at each stage before proceeding to the next. Frequently, the Nevada tests result in surprises, sometimes rude surprises, showing how far off our computer calculations actually are from reality.

Finally, even when it appears that all the physics is right, we still do not have a weapon which can withstand the harsh environmental and handling conditions that the military will subject it to. So, we have to fit our physics "package" into a warhead or bomb with all the structural supports, arming and firing mechanisms, and other engineering features that can, and usually do, perturb the physics behavior of the nuclear device. It is back again to Nevada for more nuclear tests, until we have a fully weaponized system that meets all the military requirements.

The situation today is really not much different than it was 10 or even 25 years ago. In fact, our designs are more complex today because of ever increasing military requirements which push technology to its limits. Without the capability of nuclear tests, we would be designing in a vacuum. The results would be only paper designs and we would know it. And, the designer gains little or no personal satisfaction from his work, because it does not meet the requirements inherent in applied physics research, namely to test one's theories against reality.

Scientists with the training and background necessary to be a successful nuclear weapons designer, will naturally look for new opportunities elsewhere. Opportunities abound in this country for applied physicists. In hiring scientists and engineers to work in the weapons program, we attract the cream of the crop, graduates who are seriously concerned about national security issues and who seek an invigorating environment to do applied physics research. These individuals would have no problem in landing jobs in other fields.

We can all easily agree that it is important to retain our best people and keep them constructively occupied during a CTB or a moratorium. However, this will prove to be a difficult, if not impossible task. My belief is that most scientists, engineers, and technicians need to know why the work they do is relevant. If this nation enters a CTB or a moratorium, then no matter what I or the rest of the LLNL management might say, the country is telling our people, loud and clear, their work is at best unnecessary and perhaps undesirable.

From my own experience with the weapons program, I have found that each time the suggestion of a moratorium comes up, or we undertake a "what if" exercise which can be interpreted as a signal for an imminent onset of a moratorium, our people start interviewing elsewhere. If a CTB or a moratorium arrives, I believe the exodus of these key people will begin immediately and will be impossible to prevent. This is of particular concern because there is currently a national shortage of physicists.

I suspect that a moratorium would not impact the Soviets in the same way with regard to manpower. Indeed, given the nature of their closed society, they would have much less of a problem in retaining weapons personnel in their programs. This could lead to a significant asymmetry in capability between our two countries in a relatively short time frame.

In summary, nuclear testing is a key ingredient to successful weapons designs and to making the careers of our designers fulfilling and worthwhile. It allows applied physics research that leads to products in which we can have confidence and pride. It is tangible proof that the nation considers the work done at the design laboratories both necessary and of high value. These are all key elements to maintaining the cadre of scientists and engineers essential to a vital, innovative weapons program.

Now, let me turn to a discussion of the specific impacts and consequences experienced during the 1958-1961 moratorium.

## The Nuclear Test Moratorium of 1958-1961

The nuclear test moratorium of 1958-1961 is receding from the corporate memory of the Laboratory. There are few scientists left who remember in detail the consequences of the moratorium and the impacts that it had on our national security interests. I was not at Livermore during the moratorium. Thus, my testimony is based largely on discussions with those who were there in that time period. It is also based on several excellent documents [1,2,3] which provide valuable insights on problems which arose because of our inability to perform nuclear tests as well as the impacts of the moratorium on employee morale, the technology base, and our readiness to resume testing when the moratorium ended. Some information is also available from the Congressional testimony given by various experts [4,5,6] in the years following the moratorium.

## Impacts on Manpower

Arthur Hudgins, who was responsible for the hiring and assignment of programmatic scientists from about 1955 to 1968, recollects that about 10% of Livermore's device designers and nuclear test diagnostic physicists left the

Laboratory during the moratorium. However, toward the end of the moratorium, a number of scientists had indicated their frustration and their intentions to leave within 3-6 months. The moratorium ended just in time and we were able to retain these experienced people.

In the parting interviews that Dr. Hudgins conducted with those who left, the most frequently given reason for leaving the Laboratory was the loss of ability during the moratorium to check the validity of computer calculations with nuclear tests. In particular, these individuals were concerned about the poor understanding they had of the weapon physics in the late stages of compression of a device at times just prior to explosion. This is still an area of concern to our designers. Even though our computational tools are much more advanced than they were 25 years ago, and we have a more extensive data base from many years of testing, we still lack a fundamental understanding of the phenomena involved. Dr. Batzel's testimony has already given examples regarding this point.

Dr. Hudgins has also reported the difficulties he had in trying to hire new physicists during the moratorium. Most prospective applicants perceived the moratorium as an indication that, for whatever reasons, the Government had lost interest in promoting improved designs of nuclear explosives. This image was somewhat corrected by funding during the moratorium for new and better equipped facilities and improved instrumentation. This funding, however, fell short of what was requested by the Laboratory to place us in a favorable readiness position for the possible resumption of testing.

## 1963 Testimony of Dr. John Foster

On August 1, 1963, Dr. John Foster, then Director of the Livermore Laboratory and later Director of Development, Research, and Engineering (DDR&E) in the Office of the Secretary of Defense, testified before the Preparedness Investigating Subcommittee of the Senate Armed Services Committee [4]. I believe his testimony is very relevant to the issue before us, and I would like to briefly quote pertinent portions:

"... when the moratorium came, and thinking first about the people in the Laboratory, the moratorium was a blow. It was a very serious blow. Yet many people stayed in the Laboratory through the first year, second year, and third year."

"By the third year, a number of people, important people in the Laboratory, seriously began to question whether or not they were right in that their efforts could be a major factor in the future security of the United States...."

Dr. Foster further stated:

"... Now this is an experimental science and you cannot proceed in an experimental science without experiments. And so, during this period most of the effort was concentrated on calculational procedures. We used the time to manufacture new procedures for performing the calculations and to acquire larger computing facilities, and these have served us well."

"But there is an interesting characteristic about this, and that is that the more you use a particular calculating procedure to design a device, and the more you improve it, even though you know when you start, that the calculational procedures are not based completely on fact but have in them a number of assumptions, you find yourself a year or two later believing that these calculational procedures are telling you the truth."

"Those people who are not using that particular calculation have their doubts and so during the moratorium on each of the technical questions we went after, whether it was a warhead, a question of decoupling and detection, a question of nuclear effects, there were calculations, but there grew up a wide divergence of opinion as to the validity of the calculations."

"There were no surprises during the moratorium. The first surprise in the moratorium came when the Russians resumed testing with a major effort of wide scope. That was the first and only surprise in the moratorium. When we resumed testing, surprises came with almost every test."

"Now during the moratorium we made a major effort to be ready to resume. The degree to which we failed in this effort is, in my opinion, due to three major causes. First, people felt that testing was 6 to 12 months away, and it was difficult to come down to the wire. It was difficult to keep the people at the starting blocks. Second, despite the 60 odd major letters and teletypes exchanged between the Laboratory and the AEC, it was not possible to get authorized the degree of readiness, preparations of facilities, and so on, which the Laboratory desired. And finally, when we did go back to test, we started very slowly because our skills had decayed. In particular, for example, the people who go into the field [to] assemble cables, the large number of cathode ray tubes, and so on, had just not been doing that kind of business for three years ...".

1963 Testimony of Dr. Leland Haworth

I have also found noteworthy the testimony given by Dr. Leland J. Haworth, AEC Commissioner, on June 25, 1963 to the same subcommittee before which Dr. Foster testified [5]. Dr. Haworth addressed some of the broader impacts of the moratorium:

"... At the outset of the moratorium, for the first year or so, there was no marked departure of personnel from any of these activities. This was so despite the absence of a stated national policy to maintain a maximum state of readiness or any special budgetary or other form of support for the weapons program relating to testing capabilities. This maintenance of capability came about in part because of the general belief that the moratorium would continue for only a year or so until it was determined definitely that a test ban treaty would or would not be signed. It was therefore a period of waiting, with the possibility that authorization for further tests might soon be forthcoming. In part, this capability was the product of the ingenuity of the laboratory directors and others in the program who, even without official encouragement, did what they could to persuade scientists to remain in the program and to maintain some degree of readiness."

"As the moratorium continued and plans and programs were revised, delayed, reduced, and often canceled, all of the activities bearing on a testing capability began to suffer from a loss of personnel, often the most competent of them. In the laboratories, the decline in caliber was more marked in those areas concerned with weapon physics than it was in the field of engineering and weapon production. Personnel in these latter areas were able to continue for a longer time fruitful developments based on the weapon concepts proved feasible during the previous test series."

"As the moratorium continued, activity at Enewetak was curtailed and finally this (atmospheric test) proving ground was abandoned altogether for purposes of the AEC program. The Joint Task Force (staffed by competent and dedicated officers from all the services) dwindled in size and finally was disbanded. Commands within the Armed Forces associated with nuclear testing occupied less favorable positions with respect to competition for personnel, particularly those with postgraduate training."

"Dr. Haworth went on to describe how, in spite of these declines, the country was able to develop a successful crash program when testing resumed, even though we had no advance notice. He attributed this success in part to the fact that the "laboratory directors had succeeded in persuading a sufficiently large number of talented personnel to stay on at the laboratories."

## Surprises and Design Problems Related to the 1958-1961 Moratorium

As Dr. Foster's testimony stated, "when we resumed testing, surprises came with almost every test." An extremely serious problem that existed because of the moratorium was that a number of weapon designs were conceived which failed to work as predicted when testing resumed. There were also some weapons in which we were forced to incorporate certain mechanical fixes to provide weapon safety because our inability to do nuclear tests prevented us from solving recognized problems by proper fine tuning of the physics design. The failures were of varying degrees and were due to a number of factors: a lack of understanding of the fundamental physics of nuclear explosives; an inadequate understanding of the environments in which weapons might be required to survive; improper approaches to improve weapon safety; and most important, unjustified confidence bred by non-nuclear experimentation and unverified calculations. If testing had not resumed, some of the warhead designs which would have entered the stockpile would not have worked.

Some of the problems and surprises that we experienced are described below. For classification reasons, we are limited in what we can say in open testimony. Accordingly, I have prepared a classified addendum to this testimony which goes into considerably more detail on the relevant problems.

## Minuteman II W56 One Point Safety Problem

The W56 warhead for Minuteman was developed in large part during the 1958-1961 moratorium. The W56 primary (fission trigger) was predicted by calculations not to be one-point safe and we were unable to redesign it, with confidence, to be inherently one-point safe without nuclear testing. (A device is considered to be one-point safe if it does not produce significant amounts of nuclear yield when the high explosive is accidentally detonated at a single point within the warhead.) Accordingly, Livermore provided it with a mechanical safing component. The first production unit entered the stockpile in 1963 and we later found that the safing component did not always fully complete its operation, presenting the possibility of duds. The safing system was redesigned and no further problems have been encountered. However, had we been able to conduct appropriate one-point safety tests during the crucial development years, it would have been unnecessary to have used a mechanical safing system in the first place.

## Problem with the Sergeant W52 HE

The W52 was a thermonuclear warhead for the Army's now-retired Sergeant surface-to-surface missile. The warhead was being readied for production in 1959 when two explosive accidents occurred at Los Alamos, killing four people. The explosions were due to the unexpected susceptibility to accidental detonation of the high explosive (HE) used in the W52 fission trigger.

Los Alamos decided to change the HE used in the W52 to a safer, less sensitive HE, which was also somewhat less energetic. This decision was made during the moratorium when the new design could not be verified in a nuclear test. The redesign was based on non-nuclear hydrodynamic tests and on computer design calculations.

Because of the high confidence that Los Alamos had in their redesign, they did not immediately test the W52 when the moratorium ended in 1961. The W52 first entered the stockpile in April 1962. When Los Alamos finally tested the device in early 1963, the W52 gave only a small fraction of its expected yield, and it was concluded that the weapon, as is, was militarily unacceptable.

Los Alamos scientists made a rapid redesign by adding substantially to the content of special nuclear material. Within three months of the surprise test failure, they successfully conducted a nuclear test of the new design and it was incorporated into the stockpile.

The difficulties with the W52 are an especially dramatic illustration of the limitations of non-nuclear experiments and computer calculations in the evaluation of seemingly moderate changes in warhead designs.

## Unexpected Aging Effects in the W45

Livermore developed the W45, in part, during the moratorium. The W45 was the warhead for the now-retired Little John missile and is used in the current Terrier missile and atomic demolition munition (ADM). When the W45 entered stockpile in 1962, it had not been tested to simulate certain effects of stockpile aging. Because of confidence in our calculations and other priorities, we waited until the mid sixties to test the effect of what appeared to us then to be seemingly small changes. The result was a rude surprise: the test gave only half its expected yield.

Design changes were made to the W45 and these were verified in a series of five nuclear tests. It was only on the basis of these tests that we could guarantee the performance of the various yield versions of the W45 at different stockpile ages.

## One-Point Safety of the W47 Polaris Warhead

Just before the moratorium, Livermore conducted a one-point nuclear safety test of the W47 Polaris warhead. It should have given no yield, but much to our surprise, the test gave a yield of about 100 tons. Because of the moratorium, we were unable to do the necessary tests to develop an inherently one-point safe warhead and we were forced to adopt a mechanical safing arrangement instead.

The mechanical system gave endless engineering problems in that we were unable to get it to fully complete its arming operation, even after we had incorporated what had appeared to be viable engineering fixes. A large fraction of the warheads would have been duds, and the problem would have worsened with age. We ultimately solved the one-point safety problem by replacing the primary with another known to be one-point safe. The modification was made after the new design combination was verified in a nuclear test in 1967.

Had it not been for the moratorium, it would have been possible to develop a physics solution much earlier, without having had to resort to a series of expensive, but unsuccessful, engineering solutions.

## Maintaining Laboratory Capabilities during the Moratorium

Just as the moratorium went into effect in 1958, there were differences among the three weapon laboratories, Livermore, Los Alamos, and Sandia in the nature of their backlog of available work. Los Alamos had a significant backlog of data from previous tests which they could devote effort to analyzing. Livermore, being much younger, only 6 years since its founding, had much less of a backlog of data. Sandia had considerable work to do in engineering development of weapon systems, e.g., fusing mechanisms.

Livermore and Los Alamos both had nuclear reactor projects which provided theoretical and experimental opportunities for personnel, the Pluto nuclear ramjet at Livermore and the Rover nuclear rocket at Los Alamos. Livermore also had the ongoing Sherwood project for the controlled production of thermonuclear energy.

Livermore was active in Plowshare. While we were not able to do any peaceful nuclear explosions during the moratorium, our people were kept active with conventional high explosive experiments in various locations around the country and the development of computer codes for cratering calculations. Such operational projects helped keep alive our capabilities to do field work.

Both Livermore and Los Alamos had active programs in space and atmospheric detection in support of the DARPA-sponsored Vela Programs. Only a few here were doing seismic calculations to improve our capabilities to detect underground tests. The experience gained in these areas was quite relevant to nuclear testing and kept alive many of the skills that were eventually needed when testing resumed.

Livermore devoted a large effort to enhancing its computational capability, by acquisition of more advanced computers and development of complex two-dimensional computer codes with improved physical modeling capabilities.

All of these activities helped the Laboratory, in some measure, maintain its skills in preparation for the eventual resumption of testing.

## Impact of the Moratorium on Testing Capabilities

I have already quoted from Dr. John Foster and Dr. Leland Haworth in regard to our readiness to resume testing when the Soviets broke the moratorium. I believe it is important to point out a number of other relevant issues on this subject.

A little remembered problem with the moratorium was that a series of political constraints limited activities in preparation for a possible resumption of testing. Such matters as hole and tunnel preparation or even the purchase of electrical cables for test firings and diagnostics, were severely restricted by Washington edict not to do anything that could be interpreted as violating or getting ready to terminate the moratorium. We would have liked to have installed cables in tunnels and set them up with diagnostics, ready to go on short notice if the moratorium ended.

As a result, when the Soviets abruptly resumed testing and rapidly proceeded with an extensive and well-prepared program, we had to hurry to resume testing and develop our own program. Because we were not adequately prepared, some of our tests failed unnecessarily. Most important, we were not able to carry out as extensive or as complicated effects tests as did the Soviets. This has left us at a permanent disadvantage vis-a-vis the Soviets in respect to high altitude ABM, communications, and effects phenomenology.

An excellent open literature reference [3] dealing with the moratorium is Glenn Seaborg's book, "Kennedy, Khrushchev, and the Test Ban." Seaborg was Chairman of the AEC when the Soviets broke the moratorium and observed the events first hand.

After announcing their intention to resume testing in August 1961, the Soviets detonated their first explosion on September 1, 1961. Seaborg reports that there was considerable debate in the Kennedy administration as to how to respond to the Soviet action, and in particular, how big a yield to detonate in the first U.S. test. Kennedy did not want to test in the atmosphere as the Soviets were doing.

It was generally agreed that a speedy response was in order. The U.S. detonated its first test in an NTS tunnel on Sept. 15, 1961. The yield was 6 kt, a factor of three greater than the expected yield of 2 kt. A major problem with this test was that radioactivity from the explosion extensively contaminated one of the two test tunnels and this involved an enormous cleanup task. This was only the first tunnel contamination problem we experienced when we resumed testing. We had much to learn about use of tunnels, as is evidenced by the measures we take today to contain radioactivity that we did not employ then.

Others involved with the resumption of testing have indicated that containment was not the only problem. We had little previous experience with underground tests, and had difficulties in measuring yields and obtaining diagnostic data. The tests progressed slowly, held up in part by the lack of sufficient devices to test. This shortage was primarily the result of the above-mentioned constraints in doing anything that could be interpreted as getting ready to break the moratorium.

The Soviets rapidly outpaced us in the number of tests. They, after all, had made elaborate plans for their test series, while we were caught unawares. Our test pace was limited by the restriction to test only underground. Among other factors, the drilling of test holes is very time-consuming. The President was concerned about the slow pace of the U.S. program. There was considerable pressure to resume atmospheric testing, but Kennedy was reluctant to do so. Seaborg even wrote the President saying, "...It is the conclusion of the Commission that we cannot accomplish any significant speedup in the presently planned program without resorting to atmospheric testing ...". A factor that finally convinced Kennedy to resume atmospheric tests was the need to do high altitude tests to resolve physics questions related to ABM. Once the decision was made, it took six months to put a workable plan together.

Our first atmospheric test was an air drop device detonated on April 25, 1962, off Christmas Island. This was the start of the Dominic test series which involved 40 atmospheric tests near Christmas and Johnston islands. Previous atmospheric tests had been done at Enewetak Proving Grounds, but moratorium-induced test funding and the conviction that nuclear testing might never resume had led to the ultimate decline of Enewetak as a test area. The Dominic series included five high-altitude tests using missiles launched from Johnston Island.

Although the weapons programs had begun to lose some key, talented people, the moratorium ended in time to prevent a mass exodus. In this regard, the Soviets may have unknowingly done our country a service by ending the moratorium when they did, rather than waiting a year or more longer. We still had a large cadre of experienced and trained people who knew how to work together. Although little real field work was done prior to the Soviet resumption of testing, there was an increased effort in the six months prior to their resumption on planning. This was due in part to the Kennedy administration's disillusionment with lack of progress in the test ban talks and helped make our return to testing in 1961 feasible.

When the Dominic series was near its end, Glenn Seaborg wrote the following in his summary to President Kennedy:

"The current tests have produced many important successes. They have also yielded some surprises and some failures which confirm that we are indeed experimenting at the frontier of weapons technology. The test successes vindicate, in a large measure, the elaborate computational and certification procedures which were developed during the moratorium (1958-61). The surprises and failures serve to remind us that our theories and procedures are, at best, only approximate....

"Although not a stated objective of our test program, I believe that one of the most significant results is the fact that our laboratories have become revitalized to a major degree. The importance of this reawakening of our defense posture cannot be overstressed."

I believe that the single most important message in Seaborg's statement is the one dealing with the revitalization of the laboratories. If we enter another moratorium or a CTB, it is my opinion that our vitality will suffer severely.

Comparison of the US and USSR Gains after the Moratorium

In testimony [6] in August 1978 before the Panel on SALT and CTB of the Intelligence and Military Application of Nuclear Energy Subcommittee of the House Armed Services Committee, Dr. Donald Kerr, then acting Assistant Secretary of Energy for Defense Programs in the DOE, said:

"... As you are quite aware, there was a three-year moratorium in the 1958-61 time period, and it marked a real shift in the relationship of nuclear technology between the United States and U.S.S.R. At the time that moratorium began, we believe the United States enjoyed not only superiority in deployed systems but also in the sophistication and variety of nuclear weapons. The extensive Soviet post-moratorium test program did not immediately change this advantage, since it takes some number of years to transform new concepts into deployed weapons. But the Soviet tests laid the groundwork for the extensive development of the sixties, which may indeed have provided the basis for warheads that they are deploying at the present time."

Dr. Kerr further stated:

"The Soviets began in September 1961, and conducted prior to the August 1963 imposition of the limited test ban treaty about 100 tests in the atmosphere, an unknown number underground, and several at very high altitudes. The Soviet resumption caught the United States by complete surprise and totally unprepared. The United States started off with a few underground tests, mainly for political purposes to show we could also do it. We were unable to resume meaningful atmospheric tests until about April of 1962. We conducted 60 underground and 28 atmospheric tests in that year and another 25 tests, all underground, in 1963.

"The United States didn't match the Soviet test series. The Soviet tests ranged from very small yields to the largest nuclear explosive test ever conducted, one of about 60 megatons. They conducted elaborate weapons systems tests and extremely complex tests involving missiles, radars, and perhaps tests connected with an ABM system. They conducted more tests above one megaton during those two years than the United States has in its entire history. They detonated about 300 megatons in total; the United States about a tenth of that."

On the same subject, Glenn Seaborg wrote in his book:

"The Soviet program was by far the more impressive. Beginning with the start of their series on August 31, the U.S. monitored fifty Soviet atmospheric tests within a period of sixty days. It was the most intense sustained test series the world had yet seen, exceeding in megatonnage the totals reached by all preceding tests of all nuclear nations. The series of tests we began on September 15 seemed relatively puny by comparison. In the remainder of 1961 we conducted only eight tests, in a six-month period only twenty, all underground. The yields of the individual U.S. tests were generally 20 kilotons or below. In contrast to our previous optimism about underground testing, we found it at first to be slow, costly, and replete with unanticipated complications."

## My Views on a Moratorium at This Time

It has been twenty-four years since the moratorium, and our computational and non-nuclear experimental capabilities have improved substantially. Even so, as Roger Batzel's testimony has pointed out, we still encounter surprises in nuclear tests, and our ability to maintain confidence that the stockpile is functioning properly is still limited. As our computational and experimental sophistication have increased, so has the technical sophistication of the devices in the stockpile. For reasons of overall cost savings and increased weapon safety, we have continued to stockpile weapons which push the limits of our technology. They were designed with the assumption that nuclear testing would continue so that if problems ever arose with the stockpile, a nuclear test could be done to help fix it. The bottom line is that the current stockpile requires testing if it is to remain reliable.

I would regard this as a particularly inopportune time to consider a moratorium. Insofar as new weapons under development are concerned, we are about to catch up with the advances that the Soviets have made in their extensive development of new strategic systems over the last 15 years. We are developing earth penetrating warheads which will provide the capability to keep Soviet hard targets at risk, at much lower weapon yields and with reduced collateral effects, such as initiation of fires. We have made scientifically significant breakthroughs in new weapon concepts, such as the x-ray laser which may lead to new defensive weapons that might revolutionize our ability to deter nuclear war and provide for greatly enhanced stability. I could go on, but I would then be repeating the arguments presented by Dr. Batzel in his testimony given earlier.

Those of us who have followed the history of the moratorium and the debate on nuclear test bans remember full well the statement made by John F. Kennedy on March 2, 1962 in a radio and television speech to the American public. He said:

"We know enough now about broken negotiations, secret preparations, and the advantages gained from a long test series never to offer again an uninspected moratorium. Some urge us to try it again, keeping our preparations to test in a constant state of readiness. But in actual practice, particularly in a society of free choice, we cannot keep top flight scientists concentrating on the preparation of an experiment which may or may not take place on an uncertain date in the future nor can large technical laboratories be kept fully alert on a standby basis waiting for some other nation to break an agreement. This is not merely difficult or inconvenient. We have explored this alternative thoroughly and found it impossible of execution."

In regard to the current moratorium that the Soviets have announced, I would simply recall what President Kennedy also said in 1961: "The Soviet Union prepared to test while we were at the table negotiating with them. If they fooled us once, it is their fault, and if they fool us twice, it is our fault."

In closing, I am very concerned that a moratorium is just the first step towards a CTB. As long as we must rely on nuclear weapons for our national security, we will need the capability to check their performance. An unreliable and untested stockpile is an unstable deterrent. Our deterrent depends on nuclear testing and the Soviets know this.

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**Mrs. Byron.** Thank you very much, Mr. Woodruff.

Let me ask you, during the last moratorium which was observed by the United States and the Soviets, there were tests that were conducted by other nations such as Great Britain and France during that time. Do we have any idea how many tests were conducted during that time?

**Mr. Woodruff.** Well, during the actual moratorium from 1958 to 1961, I believe that there were no tests conducted during that period.

**Mrs. Byron.** There were no tests conducted by anyone during that period?

**Mr. Woodruff.** I understand that there was an absolute moratorium during that period for the allies.[1]

**Mrs. Byron.** The proponents of House Joint Resolution 3 have pointed out that it would probably be easier to verify a comprehensive test ban than it would be the 150-kiloton threshold. Could you elaborate a little bit on that?

**Mr. Woodruff.** Well, I certainly wouldn't agree with that statement. I think the verification of a comprehensive test ban is going to be rather difficult. With appropriate on-site inspection—and that is a very important caveat, because it is the type of on-site inspection in the past the Soviets have not been willing to agree with—I believe we can get the threshold for detection toward events down below 10 kilotons. Exactly where that threshold will end up is something that is of current scientific research and debate.

The thing that seems to be missing at times, however, in the discussions in regard to a verification of a comprehensive test ban, is the ability to send a probe out into deep space and conduct a test of essentially any yield with, I believe, virtually no possibility of detection.

## SPACE TECHNOLOGY

The Soviet Union demonstrated deep space probe capability in a magnificent way by landing a package on Venus, a soft landing, and getting data back from that incredibly harsh environment on the surface of that planet. With that level of technology, if they are willing to spend the money, they can send a deep space probe out—perhaps with a half a dozen nuclear weapons on board. They can send those out into space, have a diagnostic package observe those weapons explode, measure data that in fact would be impossible to obtain in an underground test because of the environment, and then telemeter that data back at their chosen period and really have quite an elaborate base from which to develop nuclear weapons.

It would be a burden, and very expensive. I am not an expert on space technology so I would not want to comment on the cost, but if you give them the technology to land a package on Venus, I think you have to give them the technology to be able to conduct a weapon test in space, and do so at any yield, and with essentially no chance of verification.

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[1] France actually did conduct 4 tests during the 1958–1961 moratorium.

Mrs. Holt asked that we comment on the threshold test ban. Dr. Robinson and I discussed this and we believe there is no difference of opinion between the laboratories insofar as compliance with the threshold test ban is concerned. Again, the problem here is how well can you verify. The way we verify the threshold test ban is by measuring a seismic signal with a seismometer and try to interpret that as a yield of explosion. You can do that to an accuracy of about a factor of two.

That results then in two problems: The first is a statistical error that is plus or minus a factor of two on the interpretation of the yield of any given event. The other is that there is an overall factor known as bias, which is the absolute calibration of the source region that we must know to find what the yield is.

We know the calibration for the testing that occurs for the U.S. program. Indeed, if you are a Soviet seismologist and you took the U.S. data and looked at it, you would make the statement that there were tests in the U.S. series that were not in compliance with the threshold test ban, tests that were over 150 kilotons. In fact, we know they are in compliance because we have another accurate method of measuring yield, which is to drill down for radiochemical samples and determine the yield in a different way than from using seismic signals.

That is really the essence of the problem that the scientists are discussing concerning the threshold test ban. The way I remember it is a phrase by Mark Twain, "There are liars, damn liars, and statisticians," and I hope I haven't offended any statisticians here today, but that is the essence of the problem.

So Dr. Kerr testified, I guess it was on May 8th, with regard to this, and clearly stated that in his opinion as the Director of Los Alamos, there was no difference of opinion between the labs. I have just read the testimony over again and I agree with that. I don't believe there is any difference of opinion insofar as whether the Soviet Union is in compliance or not. We can't say to an accuracy any better than roughly a factor of two, because of the statistical problem of interpreting yield from seismic data.

Mr. ROBINSON. If I could add to that, the words that Dr. Kerr used as to the matter of compliance with the threshold test ban is "unresolved today and is in nature unresolvable by the techniques we have." In that sense, it is a treaty that is not verifiable.

Mrs. BYRON. Mrs. Holt.

Mrs. HOLT. I have no questions.

Mrs. BYRON. Mr. Ray.

Mr. RAY. No questions.

Mrs. BYRON. Mr. Spratt.

Mr. SPRATT. No questions.

Mrs. BYRON. Mr. Stratton.

Mr. STRATTON. I am not sure that I understood Dr. Woodruff's statement. Did I understand that you said that it is possible to test these weapons in space?

## DEEP SPACE NUCLEAR TESTING

Mr. WOODRUFF. Yes, sir, that is my opinion. I believe that you could mount a program that would put a nuclear weapon and an appropriate diagnostic package on a deep space probe and that you could fly this package out to the back side of the Sun and detonate it. You could obtain data that was of sufficient value to tell you how that weapon functions, and that would not be verifiable. There would be no system today or planned for the future that would verify that that took place.

Mr. **Stratton**. Then you bring this package back again; is that the idea?

Mr. **Woodruff**. You bring the diagnostic package back—not of course the nuclear weapon. It has exploded—but the diagnostic package comes back. When it is in the appropriate position, it telemeters the data back to Earth and tells you how the weapon performed. Basically that is the same technique we use for many of the scientific missions that go into deep space, whether they be a package landed on the surface of Mars or Venus or some of the interplanetary probes.

Mr. **Stratton**. Then in connection with the SDI, we have been told that in many cases the SDI technology would explode a nuclear weapon in space and there would be no fallout, of course, because there was no stuff from the Earth to get projected into the atmosphere, and that it would have presumably no deleterious effect. Does that seem to be a little bit contradictory from what you are saying in connection with the impact of an explosion that is sent out beyond the Sun, as you say?

Mr. **Woodruff**. Well, sir, the main difference between those two is just the location relative to the Earth where you would have the explosion occur. For a weapons test that you were trying to hide, you would have that explosion occur a long distance from the Earth, hundreds of thousands of miles away from the Earth. You would measure your data, record it in a computer, store it, and then bring the package that did that recording and storing back into range of the Earth and have it transmit the data down to the scientists.

For the SDI, the problem you have to face is that the detonation of nuclear weapons occurs within a few hundred miles of the surface of the Earth. While it is true that that won't have any serious consequences to structures or people on the ground, there are effects that would occur to satellites, such as the electromagnetic pulse effect—the EMP phenomenon—on that you have to take into account when you do an SDI system architecture.

Mr. **Stratton**. The Soviets have proposed a moritorium which we have rejected. Is it possible for us to determine whether they are actually going ahead with their own testing during an alleged moratorium?

Mr. **Woodruff**. Well, sir, we can get some information that I can't go into in complete detail in an open hearing that would tell us as to the magnitude of their more normal preparations. Basically it is the interpretation of overhead satellite photography. But of course the moratorium is in fact as unverifiable as a comprehensive test ban. Indeed, in some ways, much more so in that we have no agreements for on-site inspection or any type of activities that would enhance ability to detect seismic signals from the Soviet Union, such as on-site seismic stations.

So, at least in my opinion, a moratorium is not very verifiable.

Mr. **Stratton**. Would it be possible for the Soviets to pull the same trick now that they pulled in 1958-1961? They had—I remember that occurrence very well—and the statement was made that for them to have set off the sequence of tests that they suddenly came up with, movement, that they were working at it for over a very significant period and presumably our overhead photography was not good enough at that point to detect it.

Would it be good enough today to enable us to detect setups for tests of that kind?

Mr. **Woodruff**. I am not an expert in that field, sir, and I would rather not comment on that. I think that you would be served by asking a witness that is more expert in photointerpretation of the capability of our satellites than I am.

I personally think it would be rather difficult to verify the stockpiling of test holes and the development of tunnels, and the preparation, in a clandestine way, necessary for an advanced test series at the end of a moratorium. That is my personal opinion and I need to qualify that very carefully, because I am not an expert in photographic interpretation and photosatellite capabilities.

Mr. **Stratton**. Those tests, as I recall, were in the atmosphere, were they not?

Mr. **Woodruff**. Yes, sir, they were.

Mr. **Stratton**. So it wasn't a matter of digging holes.

Mr. **Woodruff**. Yes, sir. If they wanted to go to atmospheric testing, I think they could do that.

Mr. **Stratton**. So they must have had some kind of arrangement that I would think could be observed from space just the same way you set up fireworks for the Fourth of July.

Dr. **Thorn**. If I could answer that question. I think there is absolutely no way we can tell what kind of R&D they are doing, or there is no way we can tell what they are producing. The day they want to test, all they have to do is put it in and take off and test it. There is no way we would know about it beforehand.

Dr. **Robinson**. Drawing a difference to the earlier time, there were not satellites in space at that earlier date. We could not take photographs. Today, the Soviet Union does a large number of their activities under canopies, very large canopies. Even with our space assets it is impossible to know what is occurring under those canopies.

Mr. **Stratton**. Thank you.

Mrs. **Byron**. Dr. Thorn, do you want to start?

We have got a vote on. I think we will go now. If you will excuse us, we will be back in 10 minutes.

[A short recess was taken.]

Mrs. **Byron**. The panel will reconvene.

Our next witness, Dr. Thorn, if you will proceed.

## STATEMENT OF ROBERT N. THORN, DEPUTY DIRECTOR, LOS ALAMOS NATIONAL LABORATORY

Dr. **Thorn**. Thank you.

Chairman Byron, members of the panel, I am Robert N. Thorn, Deputy Director of Los Alamos National Laboratory. Thank you for the opportunity to discuss with you the experience of the laboratory during the testing moratorium observed by the United States, the Soviet Union, and the United Kingdom from 1958 to 1961. At the time of the moratorium, I was a staff member in the theoretical division at the laboratory, engaged in the design of thermonuclear weapons, and I speak to you from that perspective.

My own and the laboratory's experience with the moratorium was not a happy one. With resumed U.S. testing in the aftermath of the moratorium, we discovered technical problems with several weapon systems. As a result of the moratorium, we lost many people from the weapon program. If it had not ended when it did, we would have remained ignorant of stockpile problems, and suffered further personnel attrition. Continued erosion of the laboratory's design and testing capabilities would have been inevitable.

Of course, times have changed, and in comparing our historical experience and the current situation, we must draw lessons only with great caution. Having said this, I believe that the 1958 to 1961 moratorium, and particularly the events that followed, can provide insights into operations under a possible future moratorium of finite duration—which must be carefully distinguished from a CTB of unlimited duration.

To fully comprehend the lessons of the moratorium, I believe it is necessary to recall the circumstances surrounding the moratorium, as well as the state of nuclear weapons R&D at the time. I am not an historian, but I will try to sketch for you the situation that surrounded and influenced our program at Los Alamos during those years.

On August 22, 1958, President Eisenhower announced that the United States was prepared to begin negotiations on a comprehensive test ban treaty agreement which would suspend nuclear tests, and establish an international control system for detecting violations of the testing suspension. In order to move these negotiations along, Eisenhower declared that once they began, the United States would be willing to do no further testing of nuclear weapons for 1 year, with the possibility of extension if circumstances justified to do so, if the Soviets also refrained from nuclear testing.

On the basis of this proposal, the United States, the Soviet Union, and the United Kingdom began negotiations in Geneva on October 31, 1958, and observed a moratorium on testing from 1958 to 1961. This was the first major postwar agreement between the United States and the Soviet Union directly affecting nuclear armaments, but it was not embodied in a written agreement and involved no agreed verification measures.

In December 1959, President Eisenhower indicated that the United States would no longer be bound by the moratorium, since the Geneva testing negotiations had stalemated. But, he said, the United States would give advanced notice if it intended to resume testing. Then, on September 1, 1961, the Soviet Union, without previous warning, resumed nuclear tests in the atmosphere. They immediately carried out a series of over 40 tests, which could only have been possible after lengthy preparations. The United States responded with an underground weapon test series, and began preparations for atmospheric tests.

In early 1962, President Kennedy, reflecting on the experience of the moratorium, a policy not committed to paper and containing no verification measures, said that in the future the United States would only consider written agreements which provided for an adequate inspection system in regard to preparations as well as testing. He emphasized that "this must be a fully effective treaty. We know enough now about broken negotiations, secret preparations and the advantages gained from a long-test series never to offer again an uninspected moratorium."

In my view, Presidents Eisenhower and Kennedy must have known they were taking a calculated risk in adhering to the moratorium. What they said during this period certainly suggests such knowledge. The Eisenhower administration had received advice from Norris Bradbury of Los Alamos and Edward Teller of Livermore, who agreed that a temporary moratorium would not seriously damage the nuclear weapons program. However, both men also agreed that if the suspension of tests lasted much beyond 2 years, the implications for the weapons program would indeed be serious, and worsen with time.

Looking back, it is by no means clear that Bradbury and others in management at Los Alamos initially believed that the United States would agree to a moratorium and we did not make the preparations for a suspension of tests that Livermore did. Los Alamos was officially informed in July 1958 that it should prepare for a moratorium in the near future.

With a moratorium in sight, some additional tests were conducted in the Hardtack I test series in the Pacific between April and August 1958. In addition, we developed and fired a large series, Hardtack II at the Nevada test site during September and October 1958, finishing somewhat frantically on October 30, the day before the moratorium went into effect. We did little else in preparation at Los Alamos.

Actually, a great many at the laboratory, including the director, believed a moratorium might be a good thing. As you might imagine, the reasons were varied. A great many were moved by the hope that finally, after over 10 years of United States efforts to get an agreement with the Russians on controlling nuclear weapons, a treaty was in sight. But for others, there was a belief that between working on Rover—an expanding program to develop a nuclear propelled rocket—and compiling and analyzing the large volume of test data at hand, our time could be very well spent in the event of a moratorium.

Still, others thought that the laboratory should be engaged in more theoretical pursuits. Bradbury himself believed that Los Alamos had let itself get too bogged down in the mass production of weapons designs, and wanted to ease up on that aspect of lab work a bit and to do more general research.

Our calculation of risks and benefits was affected by our overconfidence, perhaps one could say arrogance, in the state of our knowledge of the weapon R&D Program and weapon tests before and leading up to the moratorium. Looking back, this is astounding. The moratorium came at a time of rapid change and improvement in our nuclear weapons. The moratorium would amply demonstrate that there was much that we did not know and that we totally failed to recognize that ignorance at the time.

Nonetheless, not only did we then judge that a moratorium of limited duration was an acceptable risk, and advise the political authorities of that assessment, but we later made decisions about the extension of the moratorium in ignorance of the problems that would be revealed only when testing resumed.

Even after the nuclear testing moratorium came into effect, the United States continued to require the development of new nuclear weapons for its stockpile. Under the moratorium, the United States agreed only to stop nuclear testing, and the Government believed it was vital to our security to develop and introduce new weapon systems.

Because of this situation, we at Los Alamos were under pressure from outside and from ourselves to continue to develop and certify weapons for the stockpile that could not be tested, or at least fully tested. In terms of new designs, this led us to be more conservative than customary. It also created tension within the laboratory between those who believed the designs could be certified without nuclear tests, and those who disagreed.

Ultimately, we did certify some weapons that had not been tested, in the belief that our understanding and design codes were satisfactory. In some cases, the weapons proved out in testing after the moratorium, in others they did not. The key point here is that we went ahead and made these decisions, under the pressures of the time and our excessive belief in our theoretical understanding and design codes.

Looking back, we can see how wrong we could be when we relied on theories and models that we could not empirically demonstrate. I can only say now, with the benefit of considerable hindsight, that such reliance was—and probably would again be—an almost irresistible temptation in the absence of periodic nuclear tests to prove out our theories and validate our design calculations.

One example of the technical problems we encountered will have to suffice here—that of a weapon redesigned under the moratorium at Los Alamos that did not justify our confidence. This was the W-52 warhead for the Sergeant tactical ballistic missile. The warhead had been tested before the moratorium, but in 1959, we had two fatal accidents at Los Alamos involving detonations of large pieces of the high explosive used in this warhead. We decided that the high explosive posed an unacceptable risk in the size pieces required for this design.

I should note here that we validate the design of explosive components very extensively through local nonnuclear experiments before any nuclear tests are involved, and in this case we proceeded to do so with a safer replacement for the high explosive. Because of the moratorium, we were unusually thorough in the way we approached the problem, and by the time we were finished, there was no doubt in the minds of the designers involved that we had produced a safer design whose nuclear performance would be entirely adequate. Production was restarted with the new high explosive design, and the weapons were delivered to the military.

When the moratorium ended, we did not place a high priority on testing this warhead, and it began to enter the stockpile in 1962 without benefit of a nuclear test. When the weapon was finally tested in 1963, it failed catastrophically. After a redesign, confirmed by a nuclear test, the inoperable weapons were replaced.

In addition to illustrating the point that weapon development without complete nuclear testing led us to some serious mistakes, the W-52 experience also indicates the sort of problem that can arise from trying to modestly redesign existing weapons. In some cases, our understanding of weapon designs or of the materials used in the weapons is not complete enough to allow us to make such decisions without testing the new design, but we cannot always identify those cases.

## EFFECTS OF MORATORIUM

Certainly the problems that we discovered with the W-52 and many other nuclear weapons after the moratorium were serious issues, with serious implications for the defense and security of the United States. Yet, in my view, even more troubling and potentially more dangerous for later years were the effects of the moratorium on the laboratory's ability to continue to carry out its mission of nuclear weapon design, testing, and oversight of the weapon stockpile.

These problems were less severe than they might have been, only because the moratorium ended before we lost a lot of people or too much vital experience and capabilities. Because Los Alamos was at that time carrying out the Rover program, research on controlled nuclear fusion, and development of fission power reactors, many people were able to move into these areas from the weapon program.

Also from the many weapon tests carried out in the past, including the extensive test series in 1958, there was a large store of test data available for analysis and synthesis by the people who remained. Despite these facts, there were morale problems at the laboratory as the moratorium progressed, and had it lasted very much longer serious harm would have been done to our weapons capabilities.

We experienced two kinds of problems with maintaining our weapons design capability. The first was that, without tests, some of the designers—especially those involved in thermonuclear design—had little to do. Those who moved into the nuclear rocket program, the controlled fusion program, and the nuclear fission energy program, found that many interesting and challenging problems existed there.

Others in different areas of weapons work were able to use this hiatus to improve their theoretical understanding and improve or normalize their computerized design models, based on their analysis of data from previous nuclear tests. But as the moratorium stretched on, some people lost interest in the weapons program and accepted jobs elsewhere.

Another thing that happened was that many of the weapons people became engrossed in their new jobs, became committed to carrying out new projects, and later did not choose or were not available to return to the weapons program. Overall, there was a trickle of valuable people leaving the weapons program and the lab. This trickle soon threatened to become a torrent.

The second problem we experienced with the design operation was a tendency to become over reliant on design codes and theories. Those of us who had been in the weapons design and testing business knew, however, that design codes can never be more than an imperfect model of the current state of physics knowledge, which is itself incomplete and imperfect.

My view now, reinforced by the experience of the moratorium, is that we should only properly use design codes to interpolate between known experimental data points—that is, nuclear tests. Still, without tests to confirm our calculations, we had no choice but to rely on the codes, and inevitably there was a tendency to place too much confidence in them.

We also experienced problems with our nuclear testing capability. Our test division did assume responsibiity for the Rover Program, and this kept many of the test personnel employed in interesting work. Others worked on nuclear test detection programs associated with the possibility of underground or deep space nuclear tests.

Still others worked on nonnuclear hydrodynamic tests which continued. But the atmospheric testing capability eroded rapidly, and the joint task force responsible for carrying it out was dismantled. In general, our ability to resume nuclear weapons testing rapidly in the event of an end to the moratorium eroded, and when the moratorium ended we resumed testing only with difficulty, cost and delay.

I have given you my recollections of the problems Los Alamos encountered during the moratorium. I want to emphasize that these deleterious effects on the laboratory, which were quite severe, might have been much greater if the moratorium had lasted only 1 or 2 more years. This to my mind shows the difference between the technical risks and costs of a moratorium of short and finite duration, as compared with an unlimited test ban, on the ability of the national laboratories to carry out their responsibility for nuclear weapons research and development.

The effects of a moratorium of finite duration would, of course, be somewhat different today. Los Alamos is now larger and more diversified, so the scientific and technical base of the laboratory might be better able to absorb weapons people during a limited moratorium. And we have certainly improved and refined our theoretical understanding and calculational tools for weapons design. Furthermore, the changes being made in new designs, and the number of designs being developed, at least in conventional nuclear weapons, are not presently as large as they were in 1958. It also takes much longer for a design to move through development, testing, production, and into the stockpile today. For these reasons, the immediate effects of a short moratorium on the stockpile might not be as severe as those discovered after 1958 to 1961.

Other effects on the laboratory could be as bad or worse, however. If a problem were detected with a stockpiled weapon, for example, we would again be unable to determine its seriousness or validate proposed solutions with nuclear tests.

Such problems still do occur, and with a relatively small number of designs in the stockpile, usually intended to remain there for many years, a problem with a single design could have a serious impact on our nuclear deterrent. This problem is worsened, in my view, by the unforgiving nature of current nuclear weapon designs.

Today's designs are more complex, and more subject to problems because they are designed with the smallest tolerances possible in order to optimize the performance of the total weapon package.

For example, new designs are as reliable as military requirements stipulate, but we cannot make them more reliable without making sacrifices in some other military requirement, such as system weight. The requirements for testing are greater under these circumstances, and we must assume that we will be able to test these weapons if problems occur.

Despite this fact, the risk that we would come to rely too much on theory, codes, and nonnuclear tests during a moratorium is probably even greater today. Fewer of our designers remember the chastening experience of the moratorium, and in the years that followed, and because our calculational tools are more elaborate and refined, it is easier to believe that they truly simulate nature.

Thus, we could again be led seriously astray without the ability to validate our calculations and designs from time to time. As time went by, we would probably be tempted to develop, certify, and stockpile untested weapons again. We also would gradually lose some of the personnel, skills, and knowledge needed for weapons research, development, and testing if the moratorium were of long duration, simply because the people would gravitate toward work where they could test their theories and where active development continued.

In the event of a comprehensive test ban of unlimited duration, I expect our ability to develop new weapons would disappear. Eventually, even our ability to retain confidence in existing weapons would atrophy and disappear.

I do not see how the U.S. could remain secure without these weapons unless we had by then managed to fundamentally transform our relations with other nations. We might, however, under a comprehensive test ban, develop a strong and wholly misplaced confidence in our ability to develop and rely on nuclear weapons without testing. If we still relied on those weapons for our security, that could be the worst situation of all.

Thank you.

Mrs. BYRON. Thank you very much.

STATEMENT OF
ROBERT N. THORN, DEPUTY DIRECTOR
LOS ALAMOS NATIONAL LABORATORY
UNIVERSITY OF CALIFORNIA
BEFORE THE
HOUSE COMMITTEE IN ARMED SERVICES
SPECIAL PANEL ON ARMS CONTROL AND DISARMAMENT

## INTRODUCTION

Chairman Byron, Members of the Panel, I am Robert N. Thorn, Deputy Director of Los Alamos National Laboratory. Thank you for the opportunity to discuss with you the experience of the Laboratory during the testing Moratorium observed by the United States, the Soviet Union, and the United Kingdom from 1958 to 1961. At the time of the Moratorium, I was a staff member in the Theoretical Division at Los Alamos, where I was a designer of thermonuclear weapons.

My own and the Laboratory's experience with the Moratorium was not a happy one. With resumed U.S. testing in the aftermath of the Moratorium, we discovered technical problems with several weapon systems. As a result of the Moratorium, we lost many people from the weapon program. If it had not ended when it did, we would have remained ignorant of stockpile problems, and suffered further personnel attrition. Continued erosion of the Laboratory's design and testing capabilities would have been inevitable.

Of course, times have changed, and in comparing our historical experience and the current situation, we must draw lessons only with great caution. Having said this, I believe that the 1958-1961 moratorium, and particularly the events that followed, can provide insights into operations under a possible future moratorium of finite duration (which must be carefully distinguished from a CTB of unlimited duration).

On the basis of the Los Alamos experience in general and my own personal experience during and since the Moratorium, I believe that one enduring lesson is that even a temporary suspension of testing has technical costs and risks, the severity of which are related to the duration of that suspension. The Moratorium experience taught us that reliance on nuclear weapons requires a technology base that cannot be maintained without testing, even if temporary suspensions (moratoria) occur. I would hope that these costs and risks are recognized and balanced by the politicians and diplomats against possible political benefits that might derive from a testing moratorium.

## THE SETTING OF THE MORATORIUM

To fully comprehend the lessons of the Moratorium I believe it is necessary to recall the circumstances surrounding it, as well as the state of nuclear weapons R&D at the time. I am not an historian, but I will try to sketch for you the situation that surrounded and influenced our program at Los Alamos during those years.

On August 22, 1958, President Eisenhower announced that the United States was prepared to begin negotiations on a comprehensive test ban treaty, which would stop nuclear testing and establish an international control system for detecting violations of the testing suspension. In order to move these negotiations along, Eisenhower declared that once they began, the United States would be willing to institute a moratorium on testing of nuclear weapons for a year, with the possibility of extension if circumstances justified doing so and if the Soviets did the same. This U.S. offer for a bilateral test moratorium of definite and limited duration came a day after an International Conference of Experts reported on the possibility of detecting violations of a possible nuclear test ban treaty. The conclusion of the experts was that effective enforcement of a treaty suspending nuclear tests would be technically possible. Eisenhower's terms for a permanent suspension of nuclear testing were that the limitations must be part of a negotiated agreement, that the limitations would continue only if an inspection system was installed and working effectively, and even then, that the suspension of nuclear weapons testing was not, in isolation, a valid arms control or disarmament measure, and would be significant only if it led to other and more substantive agreements. It was in this hope, and the belief that verification was technically possible, that the President proposed the testing moratorium and negotiations on a test ban.

The Soviet Union agreed in August to begin negotiations on October 31, 1958, but not to the Moratorium offer. With the beginning of negotiations on that date we, along with the British, suspended all nuclear weapons testing, but Soviet testing, which had resumed on September 20, continued into early November. This Soviet test series comprised 19 shots, 7 of which were of devices over one megaton in yield. This continued Soviet testing led President Eisenhower to declare, on November 7, 1958, that the Soviet action had released the United States from any obligation under its offer to suspend nuclear weapons tests. However, he said that we would not resume testing for the time being. But if the Soviet Union did not follow suit, the United States would be obliged to reconsider its position.

Eisenhower's offer of a testing moratorium was tied to the question of whether or not the Soviets tested, but it also was tied to negotiations on a verifiable, permanent suspension of nuclear tests and to progress in disarmament. With a stalemate in Geneva a year later, Eisenhower reassessed the U. S. position. He said on December 31, 1959, that the U. S. would continue negotiations, but that the voluntary moratorium on testing would expire. President Eisenhower then said that even though we considered ourselves free to start nuclear weapons testing again, we would not resume such tests without announcing our intention to do so in advance. And, he said something that we at the Laboratory all knew -- while we continued the voluntary suspension of nuclear weapon tests, the United States was continuing its program of weapon research, development and laboratory experimentation.

Khrushchev expressed regret and anxiety about President Eisenhower's statement, which he said meant the United States might resume nuclear explosions at any moment. Nevertheless, he gave no indication that the Soviets would use the President's statement as a pretext for continued testing. On the the contrary, he said the Soviets would continue to abide by their pledge so long as the Western powers did. The Soviets suggested that the first state to resume testing would be acting illegally and immorally, and could expect the other states possessing nuclear weapons to follow suit. Nevertheless, it was they who, without notice, resumed testing on September 1, 1961. Giving evidence of careful preparation during the Moratorium that went far beyond actions required to retain a testing capability, the Soviets undertook over forty tests in two months. These included high altitude, rocket-launched tests. And when President Kennedy on September 5th ordered the resumption of U. S. underground testing , obviously in response to continued Soviet testing, the Soviets said that the U. S. action would provoke a new round of the arms race.

In early 1962 President Kennedy, reflecting on the experience of the Moratorium, a policy not committed to paper and containing no verification measures, said that in the future the U.S. would find acceptable only written agreements which provided for an adequate inspection system in regard to preparations as well as testing. He emphasized that "this must be a fully effective treaty. We know enough now about broken negotiations, secret preparations and the advantages gained from a long test series never to offer again an uninspected moratorium."

In my view, Presidents Eisenhower and Kennedy must have known they were taking a calculated risk in adhering to the moratorium. What they said during this period certainly suggests such knowledge. The Eisenhower Administration had received advice from Norris Bradbury of Los Alamos and Edward Teller of Livermore, who agreed that a temporary moratorium would not seriously damage the nuclear weapons program. However, both men also agreed that if the suspension of tests lasted much beyond two years, the implications for the weapons program would indeed be serious, and worsen with time. Even though Teller and Bradbury agreed on this much, there was disagreement between the Laboratories on the course of action to be taken. Livermore along with the Atomic Energy Commission was opposed to the suspension of testing, and looked at possible alternatives such as underground testing. Not only did they take the view that the weapons complex should do as much as possible prior to the beginning of the moratorium, but they sought to maintain capabilities after it began. For example, they sought increased funding for programs like Plowshare (peaceful nuclear explosions) and Pluto (an air-breathing nuclear propulsion system).

We took a different view. Looking back, it is by no means clear that Bradbury and others in management at Los Alamos initially believed that the United States would agree to a moratorium, and we did not make the preparations for a suspension of tests that Livermore did. Los Alamos was officially informed in July 1958 that is should prepare for a moratorium in the near future. With a moratorium in sight, some additional tests were conducted in the Hardtack I test series in the Pacific between April and August, 1958. In addition, we developed and fired a large series, Hardtack II, at the Nevada Test Site during September and October 1958, finishing somewhat frantically on October 30, the day before the Moratorium went into effect. The tests were intended to complete development by confirming the safety of many of our new weapon designs and concepts. But, as is usually the case, not all of the tests confirmed expectations and many questions remained unresolved as the Moratorium went into effect. We did little else.

Actually, a great many at the Laboratory, including the Director, believed a moratorium might be a good thing. As you might imagine, the reasons were varied. A great many were moved by the hope that finally, after over ten years of U.S. efforts to get an agreement with the Russians on controlling nuclear weapons, a treaty was in sight. But for others there was a belief that between working on Rover (an expanding program to develop a nuclear propelled rocket), and compiling and analyzing the large volume of test data at hand, our time could be very well spent in the event of a moratorium. Still others thought that the Laboratory should be engaged in more theoretical pursuits. Bradbury himself believed that Los Alamos had let itself get too bogged down in the mass production of weapons designs, and wanted to ease up on that aspect of Lab work a bit and to do more general research.

Our calculation of risks and benefits was affected by our overconfidence, perhaps one could say arrogance, in the state of our knowledge of the weapon R&D program and weapon tests before and leading up to the Moratorium. Looking back, this is astounding. The Moratorium came at a time of rapid change and improvement in our nuclear weapons. In 1952 we had demonstrated that nuclear fusion as well as fission was possible, and in the next few years we developed some large-yield (but large and unwieldy) thermonuclear weapons that represented an emergency military capability. The years leading up to the Moratorium were very busy for the design Laboratories. We were developing thermonuclear designs that would allow for more militarily acceptable weapons, improved and smaller fission weapons, new safety features, etc. The military was calling for weapons for a variety of military applications, including ballistic missile warheads, nuclear artillery, land mines, air defense weapons, anti-submarine weapons, and the like. In the normal course of events many of these weapons would have been developed and tested during 1958 and 1959, and deployed in subsequent years.

We had developed many ways to test nuclear weapons, and a number of diagnostic methods beyond those used at Trinity. We had established nuclear test sites in Nevada and in the South Pacific with permanent, experienced staffs. With this testing organization established and operating, we had learned many things about the way nuclear weapons worked, and about their effects (blast, radiation, etc). We recognized that we were just learning about underground testing, and that we did not fully understand such things as high-altitude explosions, the safety features of some weapons design, and the like. The moratorium would amply demonstrate that there was much that we did not know, and experience later showed that we totally failed to recognize our ignorance at the time. Nonetheless, not only did many then judge that a moratorium of limited duration was an acceptable risk, and advise the political authorities of that assessment, but we later supported decisions about the extension of the moratorium in ignorance of the problems that would be revealed only when testing resumed.

## LESSONS OF THE MORATORIUM: WEAPONS PROBLEMS AND TECHNICAL ISSUES

Even after the nuclear testing Moratorium came into effect, the United States continued to require the development of new nuclear weapons for its stockpile. Under the Moratorium the United States agreed only to stop nuclear testing, and the government believed it was vital to our security to develop and introduce new weapon systems. The Moratorium period was, in fact, one of rapid growth and change in U. S. weapon systems. These were the years after Sputnik, and the U. S. was pressing hard to develop land-based and sea-based ballistic missiles to supplement our bombers; the U. S. had also agreed to rely more heavily on nuclear weapons to defend NATO, and was developing a variety of new theater and tactical weapon systems for that purpose. These included ballistic missiles, bombs, artillery, land mines, etc. All of these weapon systems required new nuclear warheads. The Laboratories were also in the midst of developing technically improved weapons, including weapons with better safety features.

Because of this situation, we at Los Alamos were under pressure from outside and from ourselves to continue to develop and certify weapons for the stockpile that could not be tested. In terms of new designs, this led us to be more conservative than customary. It also created tension within the Laboratory between those who believed the designs could be certified without nuclear tests, and those who disagreed. Ultimately, we did certify some weapons that had not been tested, in the belief that our understanding and design codes were satisfactory. In some cases the weapons proved out in testing after the Moratorium, in others they did not. The key point here is that we went ahead and made these decisions, under the pressures of the time and our excessive belief in our theoretical understanding and design codes. Looking back, we can see how wrong we could be when we relied on theories and models that we could not empirically demonstrate. I can only say now, with the benefit of considerable hindsight, that such reliance was (and probably would again be) an almost irresistible temptation in the absence of nuclear tests to prove out our theories and validate our design calculations.

An example of a weapon redesigned under the Moratorium at Los Alamos that did not justify our confidence was the W-52 warhead for the Sergeant tactical ballistic missile. The warhead had been tested before the Moratorium, but in 1959 we had two fatal accidents at Los Alamos involving detonations of large pieces of the high explosive used in this warhead. We decided that the high explosive posed an unacceptable risk in the size pieces required for this design. I should note here that we validate the design of explosive components very extensively through local non-nuclear experiments before any nuclear tests are involved, and in this case we proceeded to do so with a safer replacement for the high explosive. Because of the Moratorium, we were unusually thorough in the way we approached the problem, and by the time we were finished there was no doubt in the minds of the designers involved that we had produced a safer design whose nuclear performance would be entirely adequate. Production was restarted with the new high explosive design, and the weapons were delivered to the military.

When the Moratorium ended, we did not place a high priority on testing this warhead, and it began to enter the stockpile in 1962 without benefit of a nuclear test. When the weapon was finally tested in 1963, it failed. After a redesign, confirmed by a nuclear test, the inoperable weapons were replaced. In addition to illustrating the point that weapon development without complete nuclear testing led us to some serious mistakes, the W-52 experience also indicates the sort of problem that can arise from trying to redesign existing weapons. In some cases our understanding of weapon designs or of the materials used in the weapons is not complete enough to allow us to make such decisions without testing, but we cannot always identify those cases.

A different consequence of the Moratorium was our discovery from test results after the Moratorium ended that we had not fully understood the effects on nuclear weapons of the aging of a portion of the weapon's nuclear fuel, in this case the hydrogen isotope tritium. Tritium is used to attain high efficiency in fission devices, but it degrades over a period of a few years through radioactive decay. Prior to the moratorium we tested all our weapons with tritium that had not decayed, thinking that we understood the nature and effects of tritium decay and could compensate for it in stockpiled weapons. After the Moratorium ended we discovered by testing that this judgment was unfounded. Some of the basic physical data we were relying on were wrong. Of course we did not know this at the time, but others might have discovered it, because the incorrect data were in the open literature. The problem finally surfaced because pressures on the designers to increase the interval between changes of limited lifetime components--those containing tritium--convinced us to conduct a test to confirm our design judgments. That test was a dramatic failure. Because, at the time, we did not know the reason for the failure, this result placed a serious cloud of uncertainty over much of the stockpile. With the knowledge then available the only way to remove that uncertainty was by doing appropriate nuclear tests for each system of concern. Because the Moratorium had ended, we could test each suspect weapon at its scheduled maximum age and make necessary decisions and adjustments to restore our confidence in the stockpile.

The Moratorium also posed problems and technical issues associated with the safety of nuclear weapons, in particular, the development of "one-point safe" weapons. (A nuclear weapon that is one-point safe is one that has a negligible chance of producing nuclear yield if its high explosive is detonated at any single point.) Concerns with possible accidents had led to one point safety requirements, testing of existing weapons for one-point safety, and the development of nuclear designs in the mid-1950s which would be inherently one-point safe; that is, the design itself was such as to meet the safety criteria. Some one-point safe weapons were tested in the Hardtack test series, others were not yet fully tested when the Moratorium arrived, and some had not yet been designed. Still, we kept looking for ways to make safer weapons and insure that weapons entering the stockpile were safe enough, even under the Moratorium. One answer was for the design laboratories to add mechanical safing devices to their weapons. This practice led to serious problems with the operation of some weapons, and might in fact have "dudded" a whole class of weapons like the W-47 Polaris warhead.

I should note here that problems of this kind do not occur only in the distant past. A very recent experience shows that we still can make mistakes in spite of the great advances in our computers and experimental techniques. The case involved one of our most important new strategic systems. Safety requirements for this weapon were especially tight, as were the constraints placed on the delivery system for which it was being designed, and there were still other considerations that made this a particularly challenging assignment. In spite of all of these sometimes conflicting priorities, we were entirely confident that the weapon we designed would perform as required.

After the design was completed and and certified for production, another contingency was brought up that had not been duplicated in the test program up to that time. Most of the key participants judged that no furtner test was required in order to have high confidence in the weapon under all circumstances, but a few, mindful of past misadventures, convinced us we should do another test simulating the new conditions. When this test was done (after production had started) it failed dramatically. The weapon would fail under certain conditions that it very likely would encounter. Because we were able to do additional nuclear tests, we could confirm the performance of a replacement design expeditiously, and production was interrupted only briefly.

## LESSONS OF THE MORATORIUM: MAINTAINING OUR RESEARCH, DEVELOPMENT, AND TESTING CAPABILITY

Certainly the problems that we discovered with many nuclear weapons after the Moratorium were a serious issue, with serious implications for the defense and security of the United States. Yet in my view, even more troubling and potentially more dangerous for later years were the effects of the Moratorium on the Laboratory's ability to continue to carry out its mission of nuclear weapon design, testing, and oversight of the weapon stockpile. These problems were less severe than they might have been, only because the Moratorium ended before we lost a lot of people or too much vital experience and capabilities. Because Los Alamos was at that time carrying out the Rover program, research on controlled nuclear fusion, and development of fission power reactors, many people were able to move into these areas from the weapon program. Also, from the many weapon tests carried out in the past, including the extensive test series in 1958, there was a large store of test data available for analysis and synthesis by the people who remained. Despite these facts, there were morale problems at the Laboratory as the Moratorium progressed, and had it lasted very much longer serious harm would have been done to our weapons capabilities.

We experienced two kinds of problems with maintaining our weapons design capability during the Moratorium. The first was that, without tests, some of the designers (especially those involved in thermonuclear design) had little to do. Those who moved into the nuclear rocket program, the controlled fusion program, and the nuclear fission energy program, found that many interesting and challenging problems existed there. Others in different areas of weapons work were able to use this hiatus to improve their theoretical understanding and improve or normalize their computerized design models, based on their analysis of data from previous nuclear tests. But as the Moratorium stretched on, some people lost interest in the weapons program and accepted jobs elsewhere. I myself was one of the few people left at the Lab in my area of thermonuclear design, and I finally decided to accept a job elsewhere. In fact, I was within a week of leaving Los Alamos when the Soviets resumed nuclear testing in 1961. Another thing that happened was that many of the weapons people became engrossed in their new jobs, became committed to carrying out new projects, and later did not choose or were not available to return to the weapons program. Of course these effects were distributed unevenly across the Laboratory, depending on the specific tasks of different groups, morale factors, and the like. But overall there was a trickle of valuable people leaving the weapons program and the Lab. This trickle soon threatened to become a torrent.

The second problem we experienced with the design operation was a tendency to become over reliant on design codes and theories. Norris Bradbury, then Director of Los Alamos, noted in 1961 that under the Moratorium the reduction of past experience and theoretical concepts to a common calculational basis was the best available means to continue to develop new weapons. Those of us who had been in the weapons design and testing business knew, however, that design codes can never be more than an imperfect model of the current state of physics knowledge, which is itself incomplete and imperfect. My view now, reinforced by the experience of the Moratorium, is that we should only properly use design codes to interpolate between known experimental data points (ie. nuclear tests). Still, without tests to confirm our calculations, we had no choice but to rely on the codes, and inevitably there was a tendency to place too much confidence in them.

We also experienced problems with our nuclear testing capability. Our test division, J-Division, did assume responsibility for the Rover program, and this kept many of the test personnel employed in interesting work. Others worked on nuclear test detection programs associated with the possibility of underground or deep space nuclear tests. Still others worked on non-nuclear hydrodynamic tests which continued. But the atmospheric testing capability eroded rapidly, and the Joint Task Force responsible for carrying it out was dismantled. In general, our ability to resume nuclear weapons testing rapidly in the event of an end to the Moratorium eroded, and when the Moratorium ended we resumed testing only with difficulty, cost, and delay.

## APPLICABILITY TO TODAY

I have given you my recollections of the problems Los Alamos encountered during the Moratorium. I want to emphasize that these deleterious effects on the Laboratory, which were quite severe, might have been much greater if the Moratorium had lasted only one or two more years. This to my mind shows the difference between the technical risks and costs of a moratorium of short and finite duration, as compared with an unlimited test ban, on the ability of the national laboratories to carry out their responsibility for nuclear weapons research and development.

The effects of a moratorium of finite duration would of course be somewhat different today. Los Alamos is now larger and more diversified, so the scientific and technical base of the Laboratory might be better able to absorb weapons people during a limited moratorium. And we have certainly improved and refined our theoretical understanding and calculational tools for weapons design. Furthermore, the changes being made in new designs, and the number of designs being developed today, are not presently as large as they were in 1958. It also takes much longer for a design to move through development, testing, production, and into the stockpile today. For these reasons, the immediate effects of a short moratorium might not be as severe as those in 1958-1961.

Other effects on the Laboratory could be as bad or worse, however. If a problem were detected with a stockpiled weapon, for example, we would again be unable to determine its seriousness or validate proposed solutions with nuclear tests. Such problems still do occur, and with a relatively small number of designs in the stockpile, usually intended to remain there for many years, a problem with a single design could have a serious impact on our nuclear deterrent. This problem is worsened, in my view, by the unforgiving nature of current nuclear weapon designs. Today's designs are more complex and more subject to problems, because they are designed with the smallest tolerances possible in order to optimize the performance of the total weapon package. For example, new designs are as reliable as military requirements stipulate, but we cannot make them more reliable without making sacrifices in some other military requirement, such as system weight. The requirements for testing are greater under these circumstances, and we must assume that we will be able to test these weapons if problems occur.

Despite this fact, the risk that we would come to rely too much on theory, codes, and non-nuclear tests during a moratorium is probably even greater today. Fewer of our designers remember the chastening experience of the Moratorium and the years that followed, and because our calculational tools are more elaborate and refined, it is easier to believe that they truly simulate nature. Thus, we could again be led seriously astray without the ability to validate our calculations and designs from time to time. As time went by, we would probably be tempted to develop, certify, and stockpile untested weapons again. We also would gradually lose some of the personnel, skills, and knowledge needed for weapons research, development, and testing if the moratorium were of long duration, simply because the people would gravitate toward work where they could test their theories and where active development continued.

In the event of a comprehensive test ban of unlimited duration, our ability to develop new weapons would disappear. Eventually even our ability to retain confidence in existing weapons would atrophy and disappear. I do not see how the U.S. could remain secure without these weapons unless we had by then managed to fundamentally transform our relations with other nations. We might, however, under a comprehensive test ban develop a strong and wholly misplaced confidence in our ability to develop and rely on nuclear weapons without testing. If we still relied on those weapons for our security, that could be the worst situation of all.

Mrs. BYRON. Let me ask about one area that you touched on in your statement and that is the new technology that we have in computers which has moved us forward tremendously in our design phases, but it does not eliminate the test phases and I think—do you have a feeling that with a moratorium we would then probably increase the numbers of weapons that we would end up with because of the unknown factor of not being able to do accurate testing other than just the computer or on paper testing?

Dr. THORN. I think it is very likely that if we lost confidence because we couldn't test we might just put more weapons in the stockpile of different design just to hedge against the failure of any one system.

Mrs. BYRON. In other words, looking for a depth of redundancy as opposed to an elimination of some of the potential weapon systems because we are not able to test?

Dr. THORN. Yes, we would depend upon redundancy.

Mrs. BYRON. Mrs. Holt.

Mrs. HOLT. Thank you, Madam Chairman.

In looking at the hearings that the Foreign Affairs Committee had on this House Joint Resolution 3, I see a letter from Hans Bethe, Norris Bradbury, Richard Darwin, Herbert Scoville, and Paul Warnke in which they say continued nuclear testing is not necessary in order to ensure reliability of our nuclear weapons in our stockpile. The best way to ensure reliability is to disassemble sample weapons and in the past, these techniques have identified a number of reliability problems. In no case, however, was the discovery of a reliability problem dependent on a nuclear test and in no case would it have been necessary to conduct a nuclear test to remedy the problem.

Why do you think they said that?

Dr. THORN. I don't know what the motives were. I cited one example where we actually rebuilt the thing and yet when it was tested, it didn't work. There are other examples of things that have not worked either that I didn't bring up today. I think they are just mistaken. I also might point out that a number of these people are consultants for the laboratory or previous directors of the laboratory who have access to us and they haven't told us how you do this.

Mrs. HOLT. I think Bradbury was there when some of these problems occurred, the first or second Polaris, the first Poseidon. Wasn't he there then?

Dr. THORN. Yes; he was the director and I don't understand how he could make such a statement and I welcome him to come to the laboratory and tell us how to build these bombs that don't require testing. They are consultants, some of them.

Mrs. HOLT. I certainly feel strongly that we should continue our ability to test. I think it is absolutely essential and I appreciate your very comprehensive testimony. That was a very clear explanation of the history of all of this.

Thank you very much.

Mrs. BYRON. Mr. Ray.

Mr. RAY. Madam Chairman, I don't have any questions because the reports have been so thorough. I want to thank Mr. Woodruff and Mr. Thorn for their good explanation of what they are involved in there and I am grateful for you being here today.

Mrs. **Byron**. Mr. Spratt.

Mr. **Spratt**. Let me put this question to the whole panel and you may or may not be able to answer in open session. If there were to be a comprehensive test ban treaty effective January 1, 1986, what will be the impact on the ongoing development of the warheads for the D-5 and the Midgetman missiles, if any?

Dr. **Thorn**. I can speak for the D-5 missile. We have not finished our testing on that system yet and I think we would find it—some of the things I pointed out here, I think you would find a great deal of tension in the laboratory between those who thought we could do it without testing and some of us who think that it would be very difficult to certify it under those conditions.

Mr. **Woodruff**. I can comment on the Midgetman, perhaps. The baseline warhead for that is the MX warhead. The testing, if that is continued to be carried as the baseline, would be completed by that date and so we would be able to deploy that system——

Mr. **Spratt**. Using what you learn on the MX warhead?

Mr. **Woodruff**. Yes; on the other hand, the baseline, there is a great deal of study going on now as to how we should base the Midgetman missile. If that basing work should develop an option or make a recommendation for increased mobility, for example, suppose we wanted to base the Midgetman missile on a road-mobile system, then perhaps you would rather have a different warhead than the MX warhead and the testing would prevent that from being an option.

Mr. **Spratt**. What is the hypothesis?

Mr. **Woodruff**. That you have not yet in a technical community sense had a complete consensus on how Midgetman should be based.

Mr. **Spratt**. Integration of all these things?

Mr. **Woodruff**. Yes, and if you have a basing option that includes having that system be road mobile, you might want to have a different warhead developed for it than the baseline warhead at this time that had further enhanced safety options and if you could not test, it would not be possible to do that.

Dr. **Robinson**. Let me add to it a different perspective. For both the MX and the Trident D-5, there are a series of very critical tests ahead of us where we evaluate how those systems might perform in a nuclear environment, that is when going against a terminal nuclear defense as the Soviet Union has installed. Those tests are very critical to validating the design for each of these systems and those are yet ahead of us.

Mr. **Spratt**. That is the D-5 and the MX?

Mr. **Woodruff**. Yes; weapons effects testing that the defense nuclear agency undertakes the testing for.

Mr. **Spratt**. Would it be possible to have some sort of a test ban which discriminated between testing from the stockpile to maintain or to determine the reliability of current weapons on the one hand and testing new weapons to determine the validity of design so that the latter were banned and the former was permitted?

Dr. **Thorn**. I don't know how you would verify that. You have got a box and someone said this is one of our existing weapons, but how do we know that?

Mr. **Spratt**. I would think it would require intensive on-site, almost open boundaries verification. Short of that, it would take something like that to make that sort of discrimination in a test ban.

Dr. **Thorn**. You have the same problem when people talk about the PNE Treaty, how can you distinguish that from weapons treaty and you have the same problem here.

Mr. **Spratt**. Thank you very much.

Mrs. **Byron**. The only way that would work would be to give you the option to pick and pull from their pile.

I want to again thank the panel. I think the moratorium issue is one that is probably high profile right now and that we are going to be wrestling with I appreciate the input that you have given to make our job a little easier.

Thank you very much.

Mrs. **Byron**. Next we will hear from Thomas Clark, the Manager of the Nevada Operations Office, of the Nevada Test Site, Department of Energy.

## STATEMENT OF THOMAS R. CLARK, MANAGER, NEVADA OPERATIONS OFFICE, DEPARTMENT OF ENERGY

Mr. **Clark**. Chairman Byron and members of the panel, I welcome this opportunity to provide some background on events of the past related to cessation of nuclear testing and some perceptions of what the United States might face should a CTB or extended test moratorium take place.

Before I begin, I would like to call to the attention of this panel a letter from Major General Hoover to Chairman Aspin dated the 16th of September which contains some thoughtful comments on House Joint Resolution 3 from the perspective of the Department of Energy defense programs activity.

I would like to submit that for the record, if I may, please.

Mrs. **Byron**. Thank you very much. We will do that.

[The following information was received for the record:]

Department of Energy,
*Washington, DC., September 16, 1985.*

Hon. Les Aspin,
*Chairman, Committee on Armed Services, House of Representatives,*
*Washington, DC.*

Dear Mr. Chairman: The recent hearings of the House Committee on Foreign Affairs concerning House Joint Resolution 3, "To Prohibit Nuclear Explosive Testing," have been a great interest to this Department. As the Federal official charged with managing the Nation's nuclear weapons program, I want to share with you the reasons for our concern and why the Administration cannot support such legislation.

House Joint Resolution 3 recommends two major steps: to secure the ratification of the Threshold Test Ban Treaty (TTBT) and its companion Peaceful Nuclear Explosions Treaty (PNET), and to realize a resumption of negotiations toward a Comprehensive Test Ban (CTB). The Administration has problems with both recommendations. With respect to the TTBT and PNET, our experience has shown that we cannot effectively verify Soviet compliance with the treaties as they now stand. With respect to a CTB, we have concerns with the problem of verification, and the national security implications of such a treaty.

In an effort to improve U.S. ability to monitor Soviet testing, the United States has unsuccessfully sought to engage the U.S.S.R. in discussions on verification improvements to the TTBT and PNET. Moreover, the President proposed last fall in his address to the United Nations General Assembly that the United States and U.S.S.R. find a way for Soviet experts to come to the U.S. nuclear test site and for ours to go to theirs, to measure directly the yields of tests of nuclear weapons. More recently, the President reaffirmed this initiative by unconditionally inviting Soviet experts to bring any instrumentation devices the Soviet Union deems necessary to measure the yield of a nuclear test at our Nevada Test Site. His hope was that such a step would help establish the basis for verification of effective limits on underground nuclear testing. We hope that the Soviet Union will respond positively to this far-reaching U.S. initiative.

A CTB continues to be a long-term objective of U.S. arms control policy, in the context of broad, deep, and verifiable arms reductions, expanded confidence-building measures, maintenance of a credible nuclear deterrent, and improved verification capabilities. The United States has given priority to achieving equitable and verifiable arms reductions in the current Geneva negotiations on nuclear and space arms with the U.S.S.R.

Verification of a test ban remains a major problem. Even in the context of the verification procedures discussed (but not fully agreed upon) in the 1977-80 CTB trilateral negotiations, we have questions about our ability to detect and identify a potentially significant level of clandestine testing. At the multilateral Conference on disarmament in Geneva, the United States has supported international discussion of these problems, and we are continuing to work toward their resolution.

There continue to be significant concerns about the national security implications of a CTB or moratorium. The security of the United States and our allies depends on a credible nuclear deterrent, and nuclear testing plays an important role in ensuring a credible U.S. deterrent. For all the foregoing reasons the United States does not intend to pursue negotiations toward a CTB at this time.

The Administration is determined to make progress in the field of nuclear testing limitations. In particular, the Administration continues to seek means for correcting unacceptable verification problems associated with the TTBT and PNET. Recent testimony of Administration officials has made it clear that even if the United States were to ratify these twin accords and implement their current verification provisions, the verification problems would not be solved. The data exchange provision, while appearing extensive, contains not a single element that can be independtly validated by the United States.

Because of verification uncertainties and ambiguities, the Administration has been unable to reach a definitive conclusion concerning past Soviet compliance. However, for a number of tests, the totality of evidence indicates likely Soviet violations of the TTBT's 150-kiloton threshold. In addition, on a number of occasions Soviet underground nuclear tests have vented to the atmosphere, and radioactive debris from these tests has been detected beyond Soviet borders, in violation of the Limited Test Ban Treaty (LTBT). Such incidents, together with likely Soviet violations of the 150-kiloton threshold, have increased concern that any nuclear testing limitations must be effectively verifiable.

Please be assured that U.S. testing policy is fully consistent with obligations under the LTBT and the Non-Proliferation Treaty. In the preambles to those agreements, the Parties cited their determination to continue negotiations toward the elimination of nuclear weapons testing, but did so within the wilder context of the goal of general and complete disarmament which was cited as their principal aim. There is at present no obligation in any treaty operating clause [illegible] negotiate toward a test ban—although it is worthy of note that the TTBT, in Article I, Paragraph 3, would for the first time make such a commitment to CTB negotiations. Signatories to the earlier treaties recognized that a test ban cannot by itself eliminate the threat posed by nuclear weapons, and that limitations on testing must necessarily be considered within a broad range of arms reductions, both conventional and nuclear. To that end, the United States remains committed to achieving equitable and verifiable agreements leading to substantial reductions in nuclear arsenals.

In summary, the Administration does not intend to resume CTB negotiations at this time. In addition, ratification of the TTBT/PNET would be inappropriate unless a way is first found to achieve essential verification capability for these treaties so that national security concerns are met. For these reasons, the Administration cannot support the proposals of House Joint Resolution 3.

Sincerely,

WILLIAM W. HOOVER,
*Assistant Secretary for Defense Programs.*

Mr. **CLARK**. With your permission, I would like to submit my prepared statement for the record, summarize that statement, and add a few generalized observations.

As has been noted earlier in these hearings, a moratorium or a comprehensive test ban can cover a broad spectrum of options—from a total ban on all forms of nuclear testing, which would be very difficult to monitor, verify or enforce, to some limited form, which might permit testing at a much lower level than we do now.

Time is also an important factor; a 6-month moratorium might not have much significant long-term effect. Conversely, history shows that several years' cessation of testing would have a devastating effect on our ability to reconstitute a meaningful test program within any reasonable time. Each of that spectrum of options represents a different set of considerations if one wishes to maintain some capability to resume testing in the future.

As manager of DOE's Nevada operations, I am responsible for the conduct of all U.S. nuclear weapons tests. This involves the control of testing activities on the Nevada Test Site in the interest of public health and safety, as well as the operations themselves and maintenance of our testing capabilities. So long as the U.S. plans any testing in the foreseeable future, I am also responsible for the stewardship of that unique set of capabilities represented by the test site, its facilities, equipment, and perhaps most important, skilled people.

NTS is, in fact, a large outdoor engineering test laboratory to which the laboratories and DNA can bring those essential experiments they can't do at home.

In that regard, the test program is not a "program" unto itself—it is an integral and essential part of the weapons research and development program.

Finally, I am responsible for maintenance of DOE's assets for atmospheric test readiness about which I will speak in a few minutes.

Since nuclear testing began, there have been two significant events which are relevant to the CTB question. First, there was the 1958 to 1961 test moratorium, which Dr. Thorn has spoken of from personal knowledge. Second, since the Limited Test Ban Treaty of 1963, we have been obligated to maintain a capability to resume nuclear testing in the atmosphere—one of the four safeguards established in conjunction with ratification of the Limited Test Ban Treaty. Both of these experiences provide insight to what might be expected in maintaining a "readiness" capability in the event of a CTB. In preparing this testimony, I have relied on an as yet unpublished classified draft manuscript prepared for the most part by the late Dr. William E. Ogle.

I would like to point out that Dr. Robert Brownlee of Los Alamos is also present today. He is scientific advisor on atmospheric test readiness, a long-time associate of Dr. Ogle's and, in fact, is a successor to Dr. Ogle as the chief scientist for atmospheric test readiness.

This might also be an appropriate time to call to your attention an article in yesterday's Wall Street Journal by Don Cotter, a former MLC chairman. I believe that he provides an accurate impression of the 1958 to 1961 moratorium and the United States efforts in response to the Soviet breakout in 1961, but allow me to discuss the 1958 to 1961 moratorium from my own perspective.

Before and immediately after the moratorium, the test organization was quite unlike that which exists today. It was much more "ad hoc" in nature; testing was conducted on a "campaign" basis—generally 6 months at the Pacific Proving Ground, then 6 months at NTS. In calendar year 1958, after conducting 38 tests overseas, April through August, the United States returned to Nevada, where it conducted 37 tests in the 48 days between September 12 and October 30. That was a pretty active time.

Twenty-nine of those were atmospheric tests; the remaining tests were conducted in tunnels or in unstemmed vertical shafts. There were about 3,000 people involved in the NTS Program. Immediately following the establishment of the moratorium, employment levels were reduced by about 60 to 70 percent. Fortunately, other research and development projects such as the Rover and Pluto Programs, to develop space nuclear propulsion engines, provided challenging work for many of the scientists, engineers, and technicians.

I want to emphasize at this point that to retain quality people during an extended moratorium or test ban, it is vitally important that they have challenging, meaningful work; even then, once they are involved in another project, it is likely that their specialized talents would be lost to the weapons test program.

In many cases, we have invested many man-years of effort in training and developing those specialized skills which are essential to weapon testing. It would be extremely difficult to reconstitute this special body of knowledge within a reasonable time period.

As far as test readiness during the moratorium was concerned, very few activities continued. The test organization (JTF-7) deteriorated quickly and was disestablished just a few months before the moratorium came to an end. At NTS there was some tunnel reentry work, some tunnel preparation for possible future testing and a minor amount of utility and facility construction was accomplished. Practically all technical effort was stopped. Some planning was done for possible testing under the labels of Plowshare and Vela uniform.

As might be expected, when we returned to testing in 1961, the problem was attracting well-qualified people. A second problem in returning to testing was the acquisition on a timely basis of all of the state-of-the-art equipment needed to conduct the program. Although serious contingency planning appears to have begun early in 1961 as the Geneva test ban talks deteriorated, the Soviets broke out of the moratorium on September 1, 1961, and the United States was able to fire a 2-kiloton tunnel shot—which vented—on September 15; but it was not until late April 1962 that the United States was able to conduct its first atmospheric test in the Pacific.

That was an intermediate yield shot, fired in a rain cloud, they were unable to see the fireball and thus didn't get very much useful data out of it.

By the time the United States fired its first 2-kiloton test, the Soviets had fired 10 or 11 in the atmosphere, totaling about 9 megatons. Before the United States fired its first atmospheric shot, the Soviets had fired about 50, including the infamous 58 megaton shot on October 30, 1961.

My conclusions from a review of that bit of history are that, one, a capability for testing deteriorates very rapidly—the moratorium was in place for only 34 months; two, a restart, from decision time to a really meaningful test series will take a painfully long time; and three, despite constraints related to availability of specialized equipment and supplies, retention of qualified people—not only scientists, but technicians with specialized skills—not only test operations people, but weapon designers—is certain to be the greatest challenge, and probably a nearly insurmountable one if testing is not done for any extended period.

I would now like to discuss the second experience we have had—safeguard C or atmospheric nuclear test readiness. When the Limited Test Ban Treaty was ratified, four safeguards were established by Presidential directive. Safeguard C required that the United States maintain a capability to return promptly to atmospheric testing.

Early in its history, safeguard C was heavily funded—over $100 million was invested in fiscal year 1965 to modify diagnostic, drop, and sampler aircraft, and to upgrade and equip facilities at Johnston Atoll and in Hawaii.

During the first few years, this capability was exercised on such projects as monitoring foreign nuclear tests, making sun eclipse observations, studying the aurora borealis (northern lights) and conducting barium injection experiments and atmospheric weapons test dry runs.

Within a very few years, however, as budget pressures increased and as the likelihood of resumption of testing in the atmosphere diminished, the readiness program rapidly lost its momentum and support. Moreover, the safeguard C mandate was modified to delete the term "promptly" which accelerated the deterioration of the readiness capability.

Even strong supporters of the safeguards, such as the late Senator Henry M. Jackson, eventually turned their attention to more pressing matters, and in the competition for funding safeguard C progressively lost ground. Many of the physical assets became obsolete from a technological point of view and even the continued availability of real estate assets, such as Johnston Atoll, have come into question.

Most important of all, attrition took its toll of these individuals with relevant experience and the Nation's atmospheric testing cadre has, today, all but vanished.

Today, the assets of safeguard C are very limited. The NC-135 diagnostic aircraft have been taken out of service or are dedicated to other uses, the sampler aircraft have been mothballed and it is doubtful they could ever be resurrected. The photographic equipment and cloud sampling equipment is stored in New Mexico but, for the most part, would have to be replaced with modern technology. Even Johnston Atoll has utility only as a logistics base. Some scientific facilities have been maintained in a mothball status and would largely have to be rehabilitated or replaced entirely to satisfy current technological requirements.

Time, technology, politics, and budgets have all served to overtake the atmospheric test readiness program. All of this has occurred even though—some might say "partly because"—there has been an aggressive underground test program.

Let me turn now to what NTS might be like under a CTB. There are more than 6,000 people on the Nevada Operations test rolls. They are located not only at the NTS, but in Las Vegas, San Ramon, Los Alamos, and Albuquerque, and near Boston, MA.

They are involved in an extremely wide range of activities including very technical, high-speed measurements and diagnostics, large hole drilling, construction, health physics, communications, meteorology, geology, hydrology, and so on. I feel that specific decisions would have to be made as to the disposition of resources and assets, which would provide some reasonable assurance that they could be mobilized in the event any such treaty or moratorium were abrogated.

Depending upon what assumptions were to be made about the nature of the CTB, one could imagine a reduction of the work force from its current level of about 6,000 to around 2,500 or so. In the past, we have examined the types of work which could constructively occupy a work force of this size. Nonnuclear SDI comes to mind as an example. Even so, endeavors of that sort might salvage some scientific and technical people, but would not enable us to keep many of our highly specialized craftsmen, such as those who can prepare gas-blocked diagnostic cable.

In summary, I believe the experience after the 1958 to 1961 moratorium found America's testing community was technically agonizing, operationally painful, and economically very costly. Similarly, the atmospheric readiness program has revealed that such a capability can be retained for only a relatively short time. Even at that, we have had many scientists and engineers, technicians available from the underground program who could have been reassigned to support an atmospheric program if it had been reactivated.

A proposed CTB would have no activities such as the underground test program to provide meaningful, challenging work and to continue technological developments. It is evident to me that the sustained maintenance of a testing capability, in the absence of some level of full-scale testing, is to say the least, an unrealistic expectation.

This concludes my testimony. I would be pleased to answer any questions.

Mrs. BYRON. Thank you very much.

### PREPARED STATEMENT OF THOMAS R. CLARK

Representative Byron, members of the Panel, distinguished guests. I welcome the opportunity to provide you with some specific insight as to what has happened in the past and what we believe would likely happen to a nuclear testing capability of the United States under an extended test moratorium or CTB. As Manager of the Department of Energy's Nevada Operations Office, I am responsible for providing the equipment, facilities, and operational support for underground nuclear tests. It is also my responsibility to assure that such tests are conducted safely with due regard to public and employee safety, the environment, and full compliance with existing treaties or agreements.

A moratorium or a Comprehensive Test Ban Treaty (CTBT) can cover a broad spectrum of options ranging from a total ban on all forms of nuclear weapons testing to one in which some limited forms of testing are permitted such as experiments involving a few hundred pounds of nuclear yield. Time is also a dominant factor in evaluating the consequences and effects of a cessation of nuclear testing. For example, a six-month moratorium would likely have only a limited impact on our ability to resume a meaningful test program within a reasonable length of time. However, history has shown that an extended moratorium or a ban on testing of several years would have a devastating effect on the ability of the United States to reconstruct a meaningful and comprehensive test program within a year or more after the limitations were terminated by either party. Moreover, the consequences of a moratorium or a CTBT would depend upon the other negotiated terms and conditions as to the types of activities which would be permissible and any provisions for verification or on-site inspections.

It is clear that there are many variables and literally dozens of potential scenarios which could be postulated from the broad spectrum of extreme options cited above. However, in the absence of any firm assumptions as to the terms, conditions, and duration of any moratorium or CTBT which might be considered, I will discuss our experience with the 1958–1961 test moratorium and the Limited Test Ban Treaty (LTBT) of 1963. In both cases, the results of these limitations are a matter of record. Finally, I will discuss the potential consequences of a cessation of nuclear testing in terms of today's technology and operational concepts.

One key point which deserves particular emphasis is the fact that there are no Research and Development programs in the private or Federal sectors which parallel those of the Nuclear Weapons program. In other words, almost all of the highly advanced, state-of-the-art, hardware and software systems, which exist today were specifically developed or invented for Nuclear Weapons Test programs and have little, if any, application to other research or operational programs. Although equipment designs and esoteric concepts such as containment, cable gas blocking, sensors, etc., are well documented, there is no substitute for the actual hands-on experience represented by our body of scientists, technicians, and specialized crafts people in assuring that a nuclear weapons test can be conducted properly and even more important—safely. It is the potential degradation or loss of this unique body of experience that we should concern ourselves with, in the event of an extended moratorium or a CTBT. We know from experience that once this capability is lost, it could require many years to reconstruct.

Since nuclear testing began, there have been two significant events which are relevant to the CTB question. First, there was the 1958–1961 test moratorium. Second, since the Limited Test Ban Treaty of 1963, we have been obligated to maintain a capability to resume nuclear testing in the atmosphere—one of the four safeguards established in conjunction with ratification of the Limited Test Ban Treaty. Both of these experiences provide insight to what might be expected in maintaining a "readiness" capability. In preparing this testimony, I have relied on an as yet-unpublished classified draft manuscript prepared by the late Dr. William E. Ogle.

Before I discuss the moratorium and atmospheric test readiness, let me briefly remind you of the nuclear test mission at the Nevada Test Site (NTS) and some of the activities conducted currently in performing that mission.

Our mission at Nevada Operations is to conduct all nuclear weapons tests. We do this by drilling/mining and preparing the underground device emplacement hole or tunnel; constructing surface facilities; preparing the diagnostic package; conducting measurements; satisfying all of the environmental requirements, such as containment, meteorology and health physics; and finally provide for the general maintenance and operations of the NTS. This maintenance and operations spans a broad spectrum of activities and is analogous to running a small industrial community with all the related services, such as, housing, feeding, utilities, roads, radio, TV, security, airfields, etc. There are more than 6,000 Federal and contractor people currently involved in the Nevada Test Program. This excludes laboratory personnel since most of them are not permanently assigned to the Nevada Test Site.

With that background in mind, let me now turn to our experience during the 1958–1961 moratorium.

Prior to the moratorium, testing was conducted on a "campaign" basis—generally six months at the Pacific Proving Grounds, then six months at the Nevada Proving Ground—now designated the Nevada Test Site. In calendar year 1958, after conducting 38 tests overseas, April through August, the United States returned to Nevada, where it conducted 37 tests in the 48 days between September 12 and October 30. Twenty-nine of those were atmospheric tests; the remaining tests were conducted in tunnels or in unstemmed vertical shafts. There were about 3,000 people involved in the NTS program. Immediately following the establishment of the moratorium, employment levels were reduced by about 60 to 70 percent. Fortunately, other research and development projects such as the Rover and Pluto programs, to explore the feasibility of space nuclear propulsion, provided challenging work for many of the scientists, engineers, and technicians. I want to reempashize, at this point, that to retain quality people during an extended moratorium or test ban, it is vitally important that they have challenging, meaningful work; even then, once they are involved in another project and unless it is directly related to nuclear testing, it is likely that their specialized talents would be lost to the Weapons Test program. In many cases, we have invested many man years of effort in training and developing those specialized skills which are essential to underground nuclear weapons testing. It would be extremely difficult to reconstitute or reconstruct this special body of knowledge within a reasonable time period.

As far as test readiness during the moratorium was concerned, very few activities continued. There was some tunnel reentry work done to understand cavity formation physics, some tunnel preparation for possible future testing and minor amount of utility and facility construction was accomplished. Practically all technical effort was stopped.

As indicated, the principal problem during the moratorium was retaining competent people. As might be expected, when we returned to testing in 1961, the problem was attracting well-qualified people. The fact that the NTS is a remote location only exacerbated that difficulty. A second problem in returning to testing was the acquisition on a timely basis all of the state-of-the-art equipment needed to conduct the program. Although serious contingency planning appears to have begun early in 1961, the Soviets broke out of the moratorium on September 1, 1961, and the United States was able to fire a 2KT tunnel shot (which vented) on September 15; it was not until late April 1962 that the United States was able to conduct its first atmospheric test in the Pacific. By the time the United States fired 2KT test, the Soviets had fired 10 or 11 in the atmosphere, totalling about 9 MT. Before the United States fired its first atmospheric shot, the Soviets had fired about 50, including the infamous 58MT shot on October 30, 1961.

I would now like to discuss the second experience we have had with a program referred to as Safeguard C or Atmospheric Nuclear Test Readiness. When the Limited Test Ban Treaty was ratified four "Safeguards" were established by Presidential directive. Safeguard C required that the United States maintain a capability to return "promptly" to atmospheric testing. As a result, the Air Force was tasked to provide three NC-135 aircraft for the AEC to develop and maintain as diagnostic platforms, along with dedicated and modified B-52 drop aircraft and a fleet of cloud samplers. The DOD was also charged with maintaining Johnston Atoll in a standby readiness state. The AEC (now DOE) was responsible for maintaining the scientific facilities in the Hawaiian chain and providing the scientific cadre and equipment to diagnose a potential atmospheric test. During the first few years, this capability was exercised on such projects as monitoring foreign (French) tests, making sun eclipse observations, studying the Aurora Borealis (northern lights) and conducting barium and boron experiments and atmospheric weapons test dry runs.

Within a very few years, however, as budget pressures increased and as the likelihood of test resumption in the prohibitive environments diminished, the Readiness program rapidly lost its momentum and support. Moreover, the Safeguard C mandate was modified to delete the term "promptly" which accelerated the deterioration of the Readiness capability. Even strong supporters of the Safeguards, such as the late Senator Henry M. Jackson, eventually turned their attention to more pressing matters, and in the competition for funding Safeguard C progressively lost ground. Many of the physical assets became obsolete from a technological point of view or fell victim to neglect, and even the continued availability of real estate assets (such as Johnston Atoll) came into question. Most important of all, attrition took its toll of those individuals with relevant experience and the nation's atmospheric testing cadre has, today, all but vanished.

Today, the assets of Safeguard C are very limited. The NC-135 diagnostic aircraft have been taken out of service or are dedicated to other uses, the sampler aircraft have been mothballed and it is doubtful they could ever be resurrected. The photographic equipment and cloud sampling equipment is stored in New Mexico but, for the most part, would have to be replaced with modern technology. Even Johnston Atoll has utility only as a logistics base. Some scientific facilities have been maintained in a mothball status and would largely have to be rehabilitated or replaced entirely to satisfy current technological requirements.

Time, technology, politics, and budgets have all served to overtake the Readiness program.

Let me now turn to the NTS under a CTB today. I want to again, remind you that there are more than 6,000 people on the Nevada Operations test rolls. They are located not only at the NTS but in Las Vegas, Nevada; San Ramon, California; Los Alamos and Albuquerque, New Mexico; and near Boston, Massachusetts. They are involved in a extremely wide range of activities including very technical, high speed measurements and diagnostics, large hole drilling, construction, health physics, communications, meteorolgy, geology, hydrology, and all of the maintenace and operations functions required to run a sophisticated underground laboratory covering more than 1,350 square miles, with more than ¾ of a billion dollars worther of capital equipment and facilities. The yearly budget for nuclear test related operations exceed $400M. You can readily see that weapons testing is a significant undertaking and that specific decisions would have to be made as to the disposition of resources and assets and which would provide some reasonable assurance that they could be mobilized in the event any such treaty or moratorium were abrogated.

To consider a Test Program under a CTB requires that certain assumptions be made. There have been several considerations in the past as to how a CTB would be defined. For example, would it be a complete test ban or would some low yield, say a few hundered pounds of nuclear yield be allowed? How long will a test ban continue? Must we retain a capablity ot return promptly to nuclear testing, and, how fast must we return to current or higher levels of testing? All of these factors and more, influence the planning for a nuclear test readiness capability. If, for example, one assumes that under a readiness program, we would attempt to retain a capability to resume the present level of testing in terms of volume and complexity within one year after the treaty is terminated, the more than 6,000 people currently involved in the nuclear test program would be reduced to between 2,500 and 3,000.

The types of activities that these people would be involved in, include such things as building up our emplacement hole inventory; exploring the NTS for suitable places to conduct future tests; maintaining existing and developing new diagnostic detectors and equipment; participating in conventional high explosive experiments; maintaining the security of the NTS; and conducting environmental investigations of the long term effects of testing, etc.

You can readily see that there would be little challenging work, especially over an extended period of one or two years for this readiness cadre to perform, therefore, we will likely lose many of the best people first. It is important that meaningful work be assigned. During past deliberations, we examined the types of work which would constructively occupy a work force of this size and composition. By far, the most meaningful would be those associated with high technology Research and Development and/or Demonstration projects, such as, non-nuclear SDI programs, i.e., laster applications, etc. Activities in the area of the verification, such as seismic monitoring and onsite inspections; involvement in the use of weapons simulators; participation in high explosive and hydrodynamic, experiments; containment phenomenology, and seismic coupling experiments all would help maintain as scientific and technical capability. These types of endeavors partially satisfy the scientific and technical needs but does not address keeping some of the highly trained craft personnel in which we have invested many thousands of dollars in training to do such things as preparing gas-blocked diagnostic cable.

We have taken a cursory look at other non-weapons activities which might be assigned to the NTS and which would help retain some capability similar to what the Rover and Pluto projects did back in 1958-1961. These include such things as Commercial Waste Repository Investigations, construction and operation; expanded NEST/SANDS capability; environmental monitoring; conduct of controlled Liquid Gas spills to understand phenomenology; experiments to understand cratering using conventional high explosives; space nuclear power reactor (SP-100) testing, etc. Of course, there are many factors to be considered before such programs can be assigned anywhere. Moreover, we would want to assure that any such assigned activities would not compromise our ability to resume testing at some future date.

I would like to conclude by saying that history has shown us, as evidenced during the 1958-1961 moratorium, and in trying to maintain an atomospheric test readiness posture, resources in the form of manpower, equipment, and other assets can generally be preserved for a relatively short time, such as six months. However, degradation of technical resources depreciate rapidly beyond that point unless extraordinary measures are taken. Within two or three years, it seems doubtful that the United States could return to nuclear testing "promptly" with a meaningful technical program.

## SUMMARY

The experience after the 1958-1961 moratorium found America's testing community was technically agonizing, operationally painful, and economically very costly. Similarly, the atmospheric readiness program revealed that such a capability can be retained for only a relatively short time. However, we did have many scientists, engineers, and technicians available from the underground program which could have been reassigned to support an atmospheric test program if it had been reactivated. A proposed CTB, to my knowledge, would have no activities such as the underground test program to provide meaningful, challenging work and to continue technological developments. It is, therefore, evident that the sustained maintenance of testing capability, in the absence of some level of full-scale testing, is to say the least, an unrealistic expectation. Thank you.

Mrs. BYRON. Let me say I have come away with the feeling from some of the testimony we have heard that we have a less than optimistic result with the testing moratorium, and a less than optimistic result that we are going to find with verification. I am beginning to wonder if we are not just spinning wheels trying to come up with solutions that really aren't there yet. I think also that when we look at the overall complexity of the issue, we must continue to move forward.

Having said that, I think we need to make sure that our testing continues. At the same time I think we need to be concerned for the other nations that are involved in testing such as Great Britain, France, and the other nations that we have seen come into the arena. We tend to always look toward the Soviets as the big one and I think we have to look across the board. I think Mr. Woodruff spoke a little bit about atmospheric testing, do we have any indication that the Soviets have used captivity decoupling to detonate explosions?

Have we moved forward with our testing concerns in that area?

Mr. CLARK. Do you mean as far as verification or detection of Soviet——

Mrs. BYRON. Yes. You spent time—which was what we had requested you to do—talking about our testing facilities, our testing capabilities and I think at the same time when we are examining ours, we have to also examine what the opponents are capable of doing and in what direction they are going. I know several members of this committee, particularly one not here today; his thrust usually is in the question of either what do we have or where are we going with what we have, but he also wants to know what direction the competition is going so the comparison can be made as best as possible with what we have in our capabilities versus where they are going with their capabilities.

Mr. CLARK. I don't believe I am qualified to answer your question with any authority. I believe your next witness is Mr. Ewing, who might be able to offer some thoughts on that subject.

Mrs. BYRON. But you have a responsibility for our site and I think any time anybody has responsibility for a site, they like to know what the other guy's site is like or capabilities.

Mr. CLARK. In some respects, they have more capability than we have. We are currently testing only at NTS. We have an idea that we might at some time in the future find it necessary to test at other locations, but those locations are fairly limited. As a matter of fact, we look only at Johnston Island and Amchitka as locations where there would be any hope of testing if we could not do a particular thing at NTS.

The Soviets are clearly operating the sites. I think that was described to you in a classified session the day before yesterday.

Mrs. BYRON. Look at it from a budget aspect. You talked a bit about some of the things we used to have available which are no longer available because of budget constraints or competition for the dollar. Compared to what we are spending today, have our spending levels changed since the Carter administration?

Mr. **Clark**. For the test program?

Mrs. **Byron**. Yes.

Mr. **Clark**. Relatively, yes, I believe that is the case. At the present time, of course, we are testing at a slightly higher level in terms of total numbers of tests and I would say at a much higher level in terms of data being acquired since we are getting much more data out of each test than was the case, say, 5 years ago. And I, of course, have to emphasize again that the test program isn't a program that stands by itself. It is simply an integral part of the R&D Program as we see it today and have over many years.

Consequently, we have tradeoffs to be made within that total research development and test budget that balance the program, and we think that what we are doing today is being done effectively in that sense.

Mrs. **Byron**. Mrs. Holt.

Mrs. **Holt**. I have no questions. Thank you very much.

Mrs. **Byron**. Mr. Ray. Mr. Spratt.

Mr. **Spratt**. Do I understand your testimony on page 4 to say that if the yield of the explosion is 10 kilotons or greater then seismologists are reasonably agreed that detection is reliable?

Mr. **Clark**. I think as a general statement, yes. That is correct.

Mr. **Spratt**. Therefore, our concern with verification would be for those explosions below 10 kilotons?

Mr. **Clark**. Yes.

Mr. **Spratt**. Or 4 decoupling in a cavity or some sort of absorption of the shock?

Mr. **Clark**. Again, I think Mr. Ewing can speak with greater authority than I can on that subject because that is his field.

Mr. **Spratt**. OK. Thank you very much.

Mrs. **Byron**. I guess we need to thank you very much and we need to move on to Mr. Ewing.

Mr. **Clark**. Thank you, Madam Chairman.

Mrs. **Byron**. Mr. Ewing.

## STATEMENT OF RON EWING, DIRECTOR OF SYSTEMS AND TECHNOLOGY DIVISION, OFFICE OF INTERNATIONAL SECURITY AFFAIRS, DEPARTMENT OF ENERGY

Mr. **Ewing**. Madam Chairman and members of the panel, it is indeed a pleasure to appear before the Special Panel on Arms Control and Disarmament. With your permission, I would like to elaborate on the seismic verification issues contained in my prepared statement to the panel. I am aware that you have received extensive testimony over the last several weeks on the subject of test bans and treaty verification.

Therefore, I will try to limit my comments to what are hopefully the salient features as seen by someone whose qualifications are technical and those of a program manager responsible for implementing a significant portion of this country's seismic verification research and development.

In order to bring seismic verification into today's test ban context, let me start with the era of the comprehensive test ban treaty. You recall that the trilateral negotiations between the United States, United Kingdom, and U.S.S.R. concerning CTBT ceased in 1980. During the CTBT negotiations, however, and the technical discussions that supported them, a number of verification options were considered. It is evident from the discussions that the seismic option had emerged as the principal focus for verification, using in combination international seismic data exchange, and a prescribed network of in-country seismic stations.

Technically, in the early days, seismologists were in basic agreement that a seismic verification capability could be achieved. However, they at the same time recognized it could not likely go it alone. Most knew additional means would be required to achieve an effective verification capability.

It is worth noting that prior to the CTBT much of the seismic operational experience we had in the United States in the late 1970's and certainly much of the thinking had been centered around threshold verification issues related to both the Threshold Test Ban Treaty and the Peaceful Nuclear Explosion Treaty. In this case, our seismic experience was with rather large nuclear explosions—single yields of up to 150 kilotons—with correspondingly large seismic magnitudes.

In a very general sense, yet in a very real way, the circumstances of the late 1970's led to what I would term a justifiable degree of technical optimism, toward seismic verifiability, primarily influenced by our experience with high nuclear yields.

On the other hand, unfortunately, a heightened interest of the technical issues of a comprehensive test ban had diminished by the early 1980's—primarily as a result of the change in the political climate in 1980—the Soviets had invaded Afghanistan.

Also by that time, seismic technology and our field experience had not been advanced to a level sufficient to deal with many of the new problems posed by a CTBT. So when you look at the history, in the broadest context, you must conclude that—while we certainly had not reached the limits of the science—the technical objectives had become less clear as a result of the changing political environment.

## VERIFICATION ISSUES

To be more specific in terms of where we stand today, there are still some number of technical problems that remain related to seismic verification. Four stand out as key verification issues with regard to threshold and comprehensive test ban treaties.

Two of the issues, discrimination between nuclear explosions and natural seismic events (earthquakes) and seismic measurement uncertainties are critical to both threshold and comprehensive test bans. The other two, in-country seismic networks and cavity decoupling, are themselves not new issues, but with a few exceptions, have not been aggressively pursued, again primarily due in large measure to the change in the political climate in 1980 regarding CTBT.

Let me briefly address each of these issues and then conclude with some general observations.

Probably the foremost challenge facing seismic experts today is the discrimination between nuclear explosions and earthquakes. There is reasonable agreement among seismologists that, for nuclear explosions with yields in the tens of kilotons, reliable detection is feasible using existing technology and analytic techniques.

But when you get into the regime of low nuclear yield explosions, one simply begins to reach the situation where not only are nuclear explosions lost in the seismic noise, but also many more earthquakes occur and therefore compete with nuclear events in seismic detection, and thus our ability to detect and locate is severely impaired.

At this decreased level of nuclear yield, discrimination is likewise severely impaired or denied. Simply put, discrimination is always a difficult task; it is much more difficult at low nuclear yields. It poses a serious problem for verification of a CTBT.

Another key verification issue, primarily of threshold interest, measurement uncertainty, refers to our inability by seismic means to minimize or eliminate fundamental inaccuracies in measurement. The extent to which we can reduce the error is the subject of continuing research, experiments and frankly, to some degree, doubt.

In any case, in terms of test ban treaties, until we can find a breakthrough that sharply reduces measurement inaccuracy and the associated uncertainty, we leave open the door for justifiable argument with regard to adequate or effective verification. Simply put, both sides can claim foul, but neither can likely make it stick.

The third issue, in-country seismic networks, was the subject of lengthy discussions during the CTBT negotiations. The nature of the seismic problem indicates we will always be plagued to some degree with problems of detection, location, discrimination, and measurement uncertainty. It is in large measure the recognition of the first three of these that led to the notion of in-country seismic verification networks as a means to deal with a CTBT.

The principal attribute of the concept of an in-country network, that is, a network of seismic stations strategically located within a country's borders and optimized to the solution, is its ability to reduce the magnitude of the problems cited above. There is very good consensus among seismologists on the improvements to be gained by in-country networks in comparison to long distance—or the so-called teleseismic measurements—that are now the mainstay of our seismic data base.

The reason in-country stations remain a critical issue, however, is the fact that it is basically still an untested concept—although the DOE's regional seismic test network has taken the community a long way in understanding underlying technical problems.

The fourth issue is cavity decoupling. Cavity decoupling, as you know, is a potential technique for evading the detection of a nuclear explosion if one chooses to do so. One effective way to achieve decoupling is to literally create a large underground cavity—or use a natural one if it exists—whose dimensions are such that when a nuclear device is exploded within the cavity, for all practical purposes the energy created is absorbed within the cavity and not transferred to the surrounding earth and hence not detectable by our seismic systems.

For example, what we are talking about is, if one could achieve a decoupling factor of 10, then effectively a 10-kiloton decoupled explosion would appear to be the same as a 100-kiloton fully coupled explosion. There is general consensus that decoupling is technically feasible, but there are some number of practical problems. Our problem is that one does not know how small of a decoupling yield can be detected. In terms of seismic verification, cavity decoupling poses a very formidable problem.

So what does this all add up to? I mentioned four key issues none of which is really new—although certainly far more complex; particularly in the sense that we now better understand the details of the science and how it interrelates to verification. Seismologists have been analyzing, experimenting, and resolving various aspects of these issues, with varying degrees of success since the signing of the Limited Test Ban Treaty in 1963 and in some cases well before that.

Since that time, they have developed a large technical data base that literally includes hundreds of underground nuclear explosions and tens of thousands of earthquakes.

In addition, as a result of the research, development, and operational experience over the past 20-plus years, we find today, in the area of seismic verification a better informed verification community; improved instrumentation; highly automated centers for data processing and analysis; certainly a wealth of experts—in Government, industry, and academia—and reasonable near- and long-term R&D programs, both in DOE and the DOD.

Now, having said all that, let me now pose what I think is the pertinent question: Why, after 20-plus years of significant progress in methods for detection and discrimation, does the seismic answer of effective verifiability still elude us?

In part, the answer is the technical issues just mentioned. However, there are some practical and political reasons why the seismic community finds itself running faster, yet apparently not catching up, in terms of providing decisionmakers the confident answers needed for making policy on the national security issue of verification. The problem in one respect is like trying to paint a moving train.

Now, let me make two observations.

First, seismology since the time it became the centerpiece of test ban verification in 1963, has operated under five administrations, whose policies on verification were, to a large measure, shaped and changed by the world political environment. Therefore, seismologists, as the technicians charged with implementing their science, were caught up in a cause-and-effect mode rather than one of systematically pursuing a consistent path of research and analysis with a fixed objective.

The second observation is that until the period between 1977 and 1980, during the negotiations with the Soviets, there was again no specific goal which seismologists could concertedly pursue until, as it turned out, the Soviets agreed to in-country technology.

In fact, the notion of in-country seismic networks resulting from those negotiations for years was simply that, a notion. It was, by the way, only after the U.S. political will prevailed that the Soviets reluctantly agreed to the concept. In any case the point is that the community for the first time had a clear, comprehensive test ban seismic objective. Unfortunately, the bottom fell out in 1980 with the invasion of Afghanistan.

After that, objectives again become cloudy and it was difficult to make a clear R&D commitment to CTB although a modest level of technology development was maintained.

I suggest these perturbations and setbacks in some respects contributed more to the problem than some of the technical issues we faced. On the other hand, we have made great technical progress in seismic verification in some areas.

Further, it may be in some cases a fact that we have simply reached the limit of the science. In addition, there is no doubt the technical problems of a CTBT are more complex and more difficult to solve than those of a TTBT. Indeed, to the best of my knowledge and in my opinion, the situation today is pretty much that we have come a long way, but still have a long way to go.

In conclusion, to the extent that I have accurately described some of the key technical issues and in spite of the difficulties we still face, I think a prudent person must require credible solutions to the technical issues prior to ratifying a test ban treaty or negotiating the terms of a CTBT. Verification of compliance is in our national security interests.

Thank you.

Mrs. BYRON. Mr. Ewing, thank you very much for your testimony.

### PREPARED STATEMENT OF RONALD W. EWING

Madam Chairman, members of the panel, and distinguished guests, thank you for the opportunity to appear before the Subcommittee on Arms Control and Disarmament. As you know, the Department of Energy along with the Department of Defense has the responsibility for the research, development, testing and evaluation of systems and technology used in the verification of test ban treaties and arms control. As Director of Systems and Technology for International Security Affairs, I have the responsibility for implementing DOE's programs. One of the principal technical means adopted by the United States for test ban treaty verification uses the science of seismology where seismic means are used to detect and locate natural seismic events and nuclear explosions and discriminate between them. The statement that follows discusses seismic issues that focus on comprehensive test ban verification, but for completeness, includes threshold test ban statements as well.

In order to provide the broadest perspective and an appropriate understanding of the significance of seismic verification issues, let me start with the era of the Comprehensive Test Ban Treaty (CTBT). You will recall that the trilateral negotiations between the US, UK and USSR concerning CTBT ceased in 1980. During the CTBT negotiations and the technical discussions that supported them, a number of verification options were considered. It is evident from the disucssions that seismic verification has emerged as the principal focus for verification, using in combination international seismic data exchanges, and a prescribed network of in-country seismic stations. At the same time there was a consensus recognition that seismic verification alone could not provide sufficient verification confidence. Then and still today, most would agree that additional verification measures such as national technical means and onsite inspections are absolutely essential. It was clear that no single means was likely to provide the assurances or confidence needed by our decisionmakers responsible for national security. On the other hand, it is not surprising that seismic verification moved into the forefront of technical discussions based on the political climate at that time, plus it offered the very attractive option of limited national intrusion. Technically, seismologists were in basic agreement that a seismic verification capability could be achieved.

It is worth noting that much of the seismic operational experience in the U.S. in the late 1970's, and certainly much of the thinking, had been centered around threshold verification issues related to both the Threshold Test Ban Treaty (TTBT) and the Peaceful Nuclear Explosion Treaty (PNET). In this case, the experience was with rather large nuclear explosions (single yields of up to 150 kilotons) with correspondingly large seismic magnitudes. This accumulated experience and hence technical data base recognized and included among other factors the accuracies and threshold uncertainties associated with seismic measurements. In a very general sense, yet in a very real way, the circumstances of the 1970's led to a justifiable degree of technical optimism toward seismic verifiability, based on our experience with high nuclear yields. Unfortunately, a heightened awareness of the technical issues surrounding a comprehensive test ban had diminished by the early 1980's. Therefore, not only was our seismic experience under the assumptions of a CTBT with extremely low or "zero" yield explosions limited, but our R&D efforts had not evolved to a level of understanding adequate to cope with the problems of which we were aware but had not fully pursued.

Compared to the late 1970's, the situation, with respect to a CTB, in which we find ourselves today is one of: a better informed scientific and technical community; a better focused cadre of experts; improved seismic instrumentation; reasonably sound near- and long-term R&D programs; improved international data exchanges; highly automated centers for data processing and analysis; and various fora for debate of critical technical issues. However, in spite of these significant advances over the past 6 or 7 years, we now find many of the same issues, but with more insight, an increased technical challenge.

Before I address what I consider to be the key seismic verification concerns of both threshold and comprehensive test bans, one further comment is in order. My statement will not address the geopolitical, military and international security aspects of verification. But you can be assured that in deliberating the technical verification issues, the scientific community is cognizant of the significance that political considerations along with weapons development and test considerations, operating and deployment costs, deterrence measures and arms control options play in forming, shaping and impacting verification of compliance.

Although there are some number of technical problems related to seismic verification, four stand out as key issues in our ability to adequately verify threshold and comprehensive test ban treaties. Two of the issues, discrimination between nuclear explosions and natural seismic events (earthquakes) and seismic measurement uncertainties are critical to both threshold and comprehensive test bans. As will become apparent, discrimination difficulties are more pronounced at very low yields. The other two; in-country seismic networks and cavity decoupling (a potential evasive option) are not new issues, but with few exceptions have not been aggressively pursued, primarily due to the change in the political climate in 1980 regarding CTBT.

Probably the foremost challenge facing seismic experts today is the discrimination between nuclear explosions and earthquakes. There are incidentally two determinations that must be made prior to discrimination; the detection and the location of the event. There is reasonable agreement among seismologists that, for nuclear explosions with yields in the 10's of kilotons, reliable detection is feasible using existing technology and analytic techniques. Locating events in the same magnitude range is generally feasible. It is important to note that at very low nuclear yield explosions, however, one simply begins to reach the situation where not only are explosions lost in the seismic noise but also many more earthquakes occur and therefore compete with nuclear events in seismic detection, and thus our ability to detect and locate is severely impaired. At this decreased level of nuclear yield, discrimination is, of course, likewise severely impaired or denied. Even for the best case of discrimination, when the seismically detected magnitude of an explosion substantially exceeds the magnitudes of the majority of competing earthquakes, there still remains a finite probability of ambiguous discrimination. Simply put, discrimination is always a difficult task; it is much more difficult at low nuclear yields. If we are to provide credible seismic verification of a CTBT, then our state of the art in technology and analytics must be improved significantly in order to achieve high confidence discrimination. We find ourselves in this situation primarily because we have focused on technical means suitable for verification of threshold test bans and not in the context of a CTBT.

Another key verification issue, primarily of threshold interest, measurement uncertainty, refers to our inability by seismic means to minimize or eliminate fundamental inaccuracies in measurement. The instrumentation technology has improved and analytic techniques have indicated approaches to reduce sources of error over the years. The extent to which we can reduce the error is the subject of continuing research and experiments. Scientists generally agree improvements can be made, and we are pursuing the problem by every available means. Again in terms of test ban treaties, until we can find a breakthrough that sharply reduces measurement inaccuracy and the associated uncertainty, we leave open the door for justifiable argument with regard to adequate verification. Although one normally thinks of uncertainty as applying to threshold test ban yields in terms of weapons significance, in fact the problem carries through to low yield and in one sense comprehensive test bans as well.

The third issue, in-country seismic networks, was the subject of lengthy discussions during the CTBT negotiations. We will always be plagued to some degree with problems of detection, location, discrimination, and measurement uncertainty. It is in large measure the recognition of these facts that led to the notion of in-country seismic verification networks. The principal attribute of the concept of an in-country network, i.e., a network of seismic stations strategically located within a country's borders, is its ability to reduce the magnitude of the problems cited above. Although not a certainty, there is good consensus on the improvements to be gained in comparison to long distance seismic measurements. The reason it remains a critical issue is the fact that it is only a concept, and we have not had sufficient opportunity to operationally validate it. We have, however, over the past five years made significant progress through our R&D efforts and are convinced we are on the right track. It is correct to say our knowledge today is such that the consensus of the scientific community is one of high confidence in the value of in-country networks. There remains to be resolved the exact numbers of stations and their locations, along with the vital experience one must gain from operating the individual systems as a network.

The fourth verification issue is cavity decoupling. Cavity decoupling is a potential technique for evading the detection of a nuclear explosion if one chooses to do so. One effective way to achieve decoupling is to literally create a large underground cavity whose dimensions are such that when a nuclear device is exploded within the cavity, the energy created is absorbed within the cavity and not transferred (in the perfect case) to the surrounding earth and hence available for potential seismic detection. On the other hand, less than perfect decoupling may allow some energy to reach a seismic station but at a much reduced level. The problem is that one does not know if a small decoupled explosion can be detected. By way of example, if an evader can successfully decouple say by a factor of 100, a 5 kiloton decoupled explosion would appear to be the same as a 50 ton fully coupled explosion. With near perfect decoupling verification of a comprehensive test ban could be denied. DOE recently convened a workshop of world renowed scientists to examine the viability and feasibility of cavity decoupling. There was general consensus that decoupling is probably technically feasible, but there would be undoubtedly some number of practical problems. From the point of view of seismic verification, it would pose a formidable problem. Under the assumptions of a CTBT, the problems raised by cavity decoupling have not been suitably resolved.

In summary, let me tie together what I have said. When one looks at the problems related to adequate seismic verification of a comprehensive test ban treaty there are some key issues to be resolved. I amplified on four: discrimination (including detection and location); measurement uncertainty; in-country seismic networks; and cavity decoupling. I have intentionally avoided including a discussion of national and internationally avoided including a discussion of national and international security issues, militarily significant yields, geopolitical issues and any other factors that might have clouded the understanding of seismic verification and its significance to treaty compliance. To the extent that I have clearly articulated the seismic issues, I think that a prudent person would seek credible resolution to these problems prior to negotiating the articles of a comprehensive test ban treaty or ratification of a threshold treaty. My conclusion is based on a reasonable assumption that seismic means will remain as a principal tool for test ban treaty verification, but in terms of the issues I discussed, its technical and political adequacy is currently extremely fragile.

## NEW TECHNOLOGY

Mrs. Byron. Let me pursue a little bit the issue of seismic verification currently being looked at. Are we looking at any other new technology that will enable us to tell a nuclear explosion from any other forms of geological clutter that we now have problems with?

Mr. **Ewing**. Yes, we are. We are looking at two areas of technology. One is what we call a seismic array. We recently installed such an array in Norway and we are now collecting data to validate basically the question you asked, are we looking at other technologies.

The second thing we are doing is looking at what is known as high frequency transmission of seismic waves. There are some theoretical studies that indicate that that shows some promise, particularly of interest in the case of cavity decoupling, but it is very new and untested. It is strictly theoretical.

Mrs. **Byron**. Do you have any idea how much the administration requested last year for R&D funding in this area and in comparison with what we spent for seismic verification over the last 5 years?

Mr. **Ewing**. In the case of the Department of Energy, I do, of course. The administration requested on the order of $8 million from the Department and that is probably threefold what we were spending in 1980. Perhaps even fourfold. I can't speak quantitatively for the Department of Defense, but I know they are spending probably twice as much in this area as the Department of Energy, and I have no idea what their growth has been in the last 3 years.

Mrs. **Byron**. Mrs. Holt.

Mrs. **Holt**. Thank you, Madam Chairman, and thank you, Mr. Ewing, for that comprehensive testimony.

I still feel very pessimistic about verification. I think that is the bottom line and after listening to all of the experts talk about it, I don't feel any more optimistic about it. I like the analogy of painting a moving train. It seems to me anything we come up with they can evade and until we overcome the political problems of a closed society absolutely refusing for any kind of on-site verification or any kind of information that will give us accurate data, I don't believe we can ever come up with a way to verify it, do you?

Mr. **Ewing**. That is a very difficult question to answer. I think that as a scientist and one who has tried to look at the question you asked objectively, we are making strides in that direction.

I will submit, as I mentioned earlier, that if we are looking for absolutes, then on-site inspection is a must. You can't deny that. I think that we can get closer to the solution of the problem, but I think the real question that one has to ask is what is adequate and I think it is not exactly fair to ask the world of seismology to answer that question.

I think we as seismologists can tell you how well we can do if you can tell us what is adequate.

Mrs. **Holt**. I certainly don't intend to downplay the efforts that you are making and I commend you and I feel that we definitely have to continue in that direction. We have to do everything that we can.

Again, thank you.

Mrs. **Byron**. Mr. Ray.

Mr. **Ray**. No questions.

Mrs. **Byron**. Mr. Spratt.

Mr. **Spratt**. I asked the question of the gentleman who preceded you, having read your testimony, and thought his was yours, and I apologize. I said earlier I have a cold, I can hardly hear, but when you said in your testimony that a 150-kiloton test can be detected today through seismic devices, were you talking of seismic devices located distant from the country where the test was conducted?

Mr. **Ewing**. Yes, I am talking about the current seismic network that is in place worldwide at teleseismic distances. The answer more specifically in terms of detection, is one that we are very confident that we can detect a 100- to 150-kiloton explosion.

Mr. **Spratt**. We, of course, have the seismic detection system in place now?

Mr. **Ewing**. That is correct.

Mr. **Spratt**. And we are monitoring to the best of its capability what is going on in the way of Soviet testing at the present time?

Mr. **Ewing**. Yes sir, continuously.

Mr. **Spratt**. How do we determine that explosion is in excess of 150 kilotons? Apparently there is some suspicions that the Soviets have breached the threshold test ban.

Mr. **Ewing**. Well, in terms of the earlier testimony that we had today, the answer to that is in the measurement, a statistical determination, and the number that you heard today—I think the same number that Mr. Adelman used last week—is a factor of two, is where the uncertainty resides. So if in fact they tested at 150, we would have to say that is somewhere between 75 and 300, because we are dealing with uncertainties. There are inaccuracies in the measurements. Until, as I said in my testimony, we can find ways to reduce those inaccuracies, that is probably as good as we can do.

Mr. **Spratt**. Do you think an in-country seismic network is essential to some sort of verification system?

Mr. **Ewing**. I think it definitely is essential, but it is not sufficient.

Mr. **Spratt**. In that sense, it is not sufficient for seismologists, or would you think into the foreseeable future it would have to be supplemented with on-site inspection?

Mr. **Ewing**. I think to give me the confidence that I would want on such a critical national issue, I would want to use every available source to verify any test ban treaty.

Mr. **Spratt**. Is decoupling a major problem? I got the impression from your testimony that you didn't attribute a great deal of significance to this particular problem, the problem of being able to detonate some devices, explode some nuclear devices inside an underground cave?

Mr. **Ewing**. Well, from the one side, if the question is, is it a problem to do it, of course it is technically feasible. We have done it in this country. We feel certain the Soviets have, also, and I think that goes back to an earlier question. We know they have done cavity nuclear testing. They are in fact in a much better position to cavity test in that they have geophysical salt structures throughout their country that allow them the option.

Mr. **Spratt**. Are there salt domes?

Mr. **Ewing**. Salt domes primarily. So in that sense, if you are asking can they, then, yes, it is certainly feasible, but not without some cost and a lot of difficulty. I am not implying that it is easy, I am saying one can do it.

On the other hand, the problem that I pointed out, our problem, is our ability to detect, if one chooses to decouple, because you can in effect reduce the yields to numbers where I don't believe seismology alone can answer the question for you.

Mr. **Spratt**. One final question. You mentioned in your testimony, Afghanistan as being sort of a watershed in the last negotiations. Did the loss of any seismic listening post in Iran, if there were any, have any effect on the decision to break off negotiations?

Mr. **Ewing**. No, not in our current understanding. That had no bearing.

Mr. **Spratt**. Thank you very much.

Mrs. **Byron**. Mr. Klein.

Mr. **Klein**. No.

Mrs. **Byron**. Dr. Mansfield.

Dr. **Mansfield**. A question for Dr. Thorn.

Dr. Thorn, who was the Director of Los Alamos that certified the yield of the W-52 warhead during the time of the moratorium?

Dr. **Thorn**. Dr. Norris Bradbury.

Dr. **Mansfield**. The W-52 was the warhead which underwent a very slight redesign but failed catastrophically when it was later tested, is that correct?

Dr. **Thorn**. That is correct.

Dr. **Mansfield**. Is this the same Dr. Bradbury who signed the letter quoted by Mrs. Holt that testing wasn't necessary?

Dr. **Thorn**. Yes.

Dr. **Mansfield**. Thank you.

I have a short question for Mr. Woodruff.

Dr. Woodruff, according to your statement, existing U.S. stockpile would be in grave danger of becoming unreliable under a comprehensive test ban. Some people say this would be good because the President would hesitate to authorize the use of nuclear weapons if he wasn't sure they would work. Do you think that is a good state of affairs?

Mr. **Woodruff**. Well, I think uncertainty in an area as critical to national security as nuclear weapons is a dangerous commodity. What any President would do would depend on that individual, an equally plausible outcome to uncertainty would simply be to produce more weapons so that the net reliability of any particular military mission was the same as before the test ban started.

Dr. **Mansfield**. So the result is liable to be more weapons rather than fewer?

Mr. **Woodruff**. Yes, sir.

Dr. **Mansfield**. Most people think that arms control to be successful would reduce the number of weapons, or at least reduce the risk of war and maintain national security. In light of your answer, do you think a comprehensive test ban will reduce the risk of war or will it be symbolic?

Mr. **Woodruff**. My personal opinion on this is that a comprehensive test ban at this time would not reduce the possibilities of war. I am reminded of some words that Winston Churchill said back in 1934 in the Geneva Disarmament Conference—sort of paraphrasing—but basically that it is a mistake to have disarmament prior to having peace. You want peace first, then have disarmament, and I think the same thing applies in a technology sense. Comprehensive test ban is just one element of the problem and I feel that, especially given the asymmetries in our societies, that limitations on technologies are particularly disadvantageous to the United States, as compared to the Soviet Union, and that it would be much better served in the national security sense to pursue the agreements that limit in a quantitative way, arms, rather than technologies and research. Again, as I said, that is my personal opinion.

Dr. **Mansfield**. Thank you.

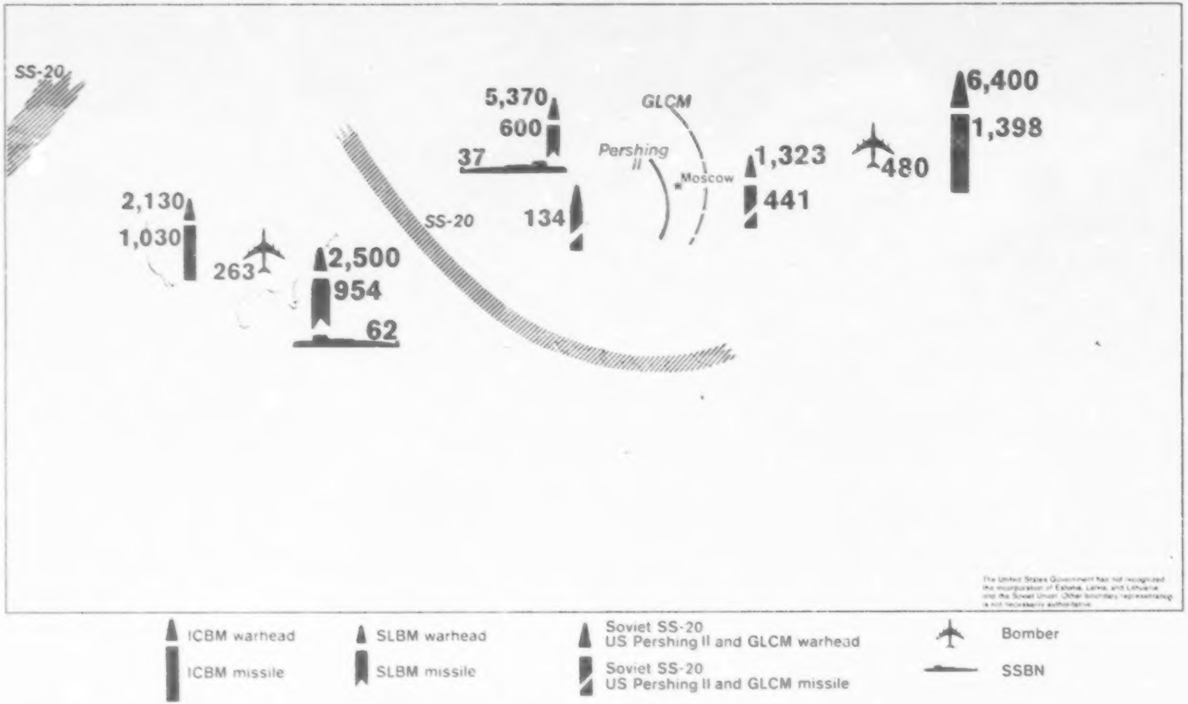
Mrs. **Byron**. Once again, I want to thank the panel, and this concludes our series of hearings for today until further call of the Chair.

[Whereupon, at 12:45 p.m., the panel was adjourned, subject to the call of the Chair.]

[The following information was received for the record:]

## Major US and USSR Systems

### Fall 1985

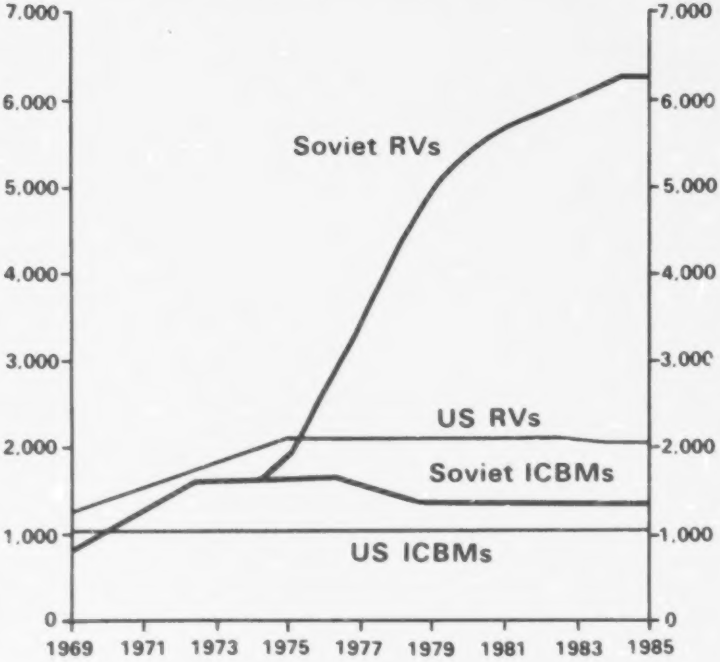

SS-20
5,370
600
37
GLCM
Pershing II
Moscow
6,400
1,398
1,323
480
441
2,130
1,030
263
2,500
954
62
SS-20
134
ICBM warhead
ICBM missile
SLBM warhead
SLBM missile
Soviet SS-20
US Pershing II and GLCM warhead
Soviet SS-20
US Pershing II and GLCM missile
Bomber
SSBN

The United States Government has not recognized the incorporation of Estonia, Latvia, and Lithuania into the Soviet Union. Other boundary representation is not necessarily authoritative.

## Current Strategic Balance:
## Operational Strategic Nuclear Forces as of September 1985

| | US | | Soviets | |
|---|---|---|---|---|
| ICBMs | 30 | Titan II | 520 | SS-11 |
| | 450 | Minuteman II | 60 | SS-13 |
| | 550 | Minuteman III | 150 | SS-17 |
| | 1030 | | 308 | SS-18 |
| | | | 360 | SS-19 |
| | | | 1398 | |
| SLBMs* | 288 | Poseidon (C-3) | 42 | SS-N-5 |
| | 312 | Trident (C-4) | 304 | SS-N-6 |
| | 600 | | 292 | SS-N-8 |
| | | | 12 | SS-N-17 |
| *Totals do not include SS-NX-23 missiles or new Trident submarine | | | 224 | SS-N-18 |
| | | | 80 | SS-N-20 |
| | | | 954 | |
| Bombers | 167 | B-52G | 140 | Bear |
| | 96 | B-52H | 40 | Bison |
| | 263 | | 300 | Backfire |
| | | | 480 | |
| Total Delivery Vehicles | 1893 | | 2832 | |
| Ballistic Missile Warheads | 7500 | | 8900 | |
| Ballistic Missile Throw-Weight | 4.4 million pounds | | 11.9 million pounds | |

## US and Soviet ICBM Launcher and Reentry Vehicle (RV) Deployment 1969–1985



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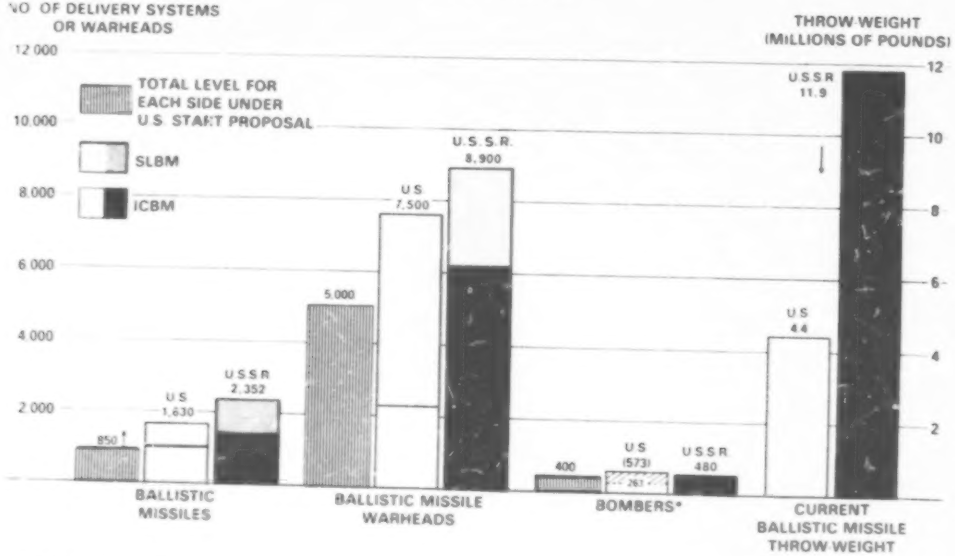
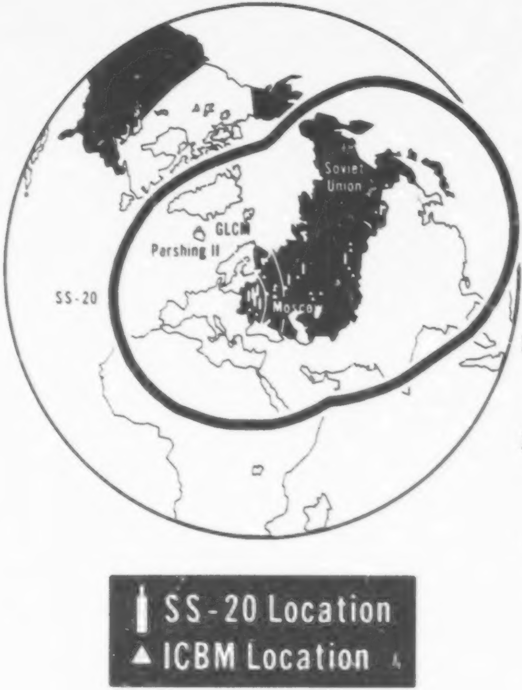
# U.S. START PROPOSAL AND THE STRATEGIC BALANCE
## FALL 1985

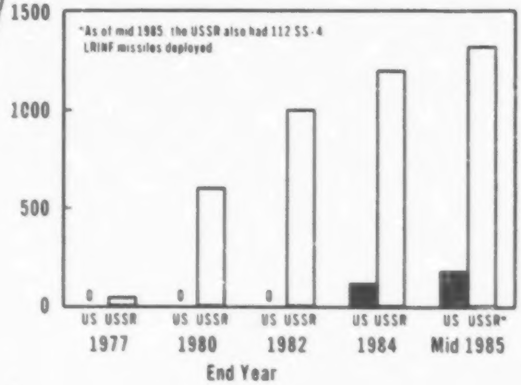


* U.S. FIGURE INCLUDES 263 OPERATIONAL B-52s
U.S.S.R. FIGURE INCLUDES BEAR, BISON, AND BACKFIRE BOMBERS

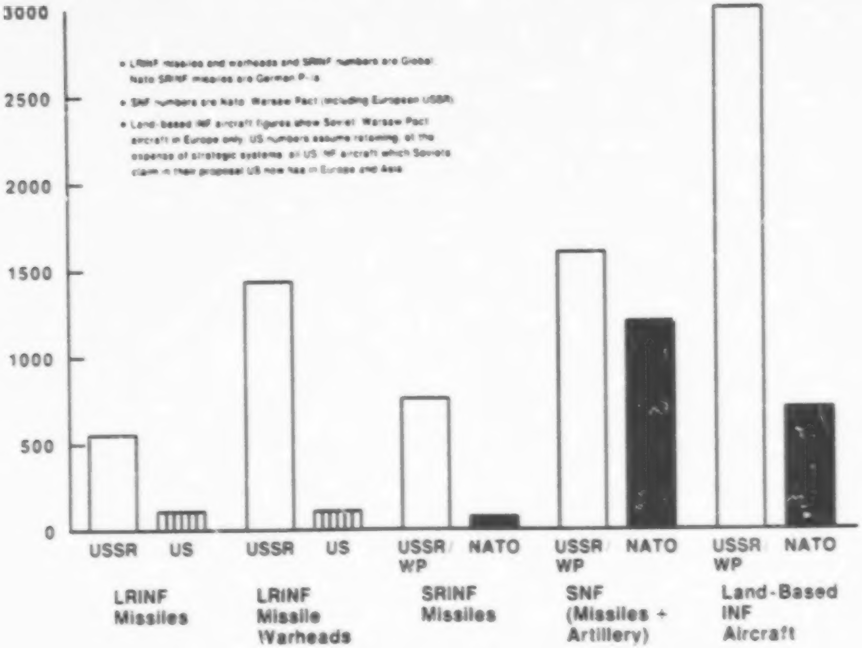
Mid 1985

# Target Coverage of Soviet SS-20 and NATO Pershing II and Ground-Launched Cruise Missiles


Soviet Union
GLCM
Pershing II
SS-20
Moscow
SS-20 Location
▲ ICBM Location


*As of mid 1985 the USSR also had 112 SS-4 LRINF missiles deployed

# INF / SNF Balance Under Soviet Freeze Proposal



- LRINF missiles and warheads and SRINF numbers are Global. Nato SRINF missiles are German P-1a
- SNF numbers are Nato/Warsaw Pact (including European USSR)
- Land-based INF aircraft figures show Soviet/Warsaw Pact aircraft in Europe only. US numbers assume rebasing, at the expense of strategic systems, of all US INF aircraft which Soviets claim in their proposal US now has in Europe and Asia

3000
2500
2000
1500
1000
500
0
USSR
US
LRINF Missiles
USSR
US
LRINF Missile Warheads
USSR/WP
NATO
SRINF Missiles
USSR/WP
NATO
SNF (Missiles + Artillery)
USSR/WP
NATO
Land-Based INF Aircraft

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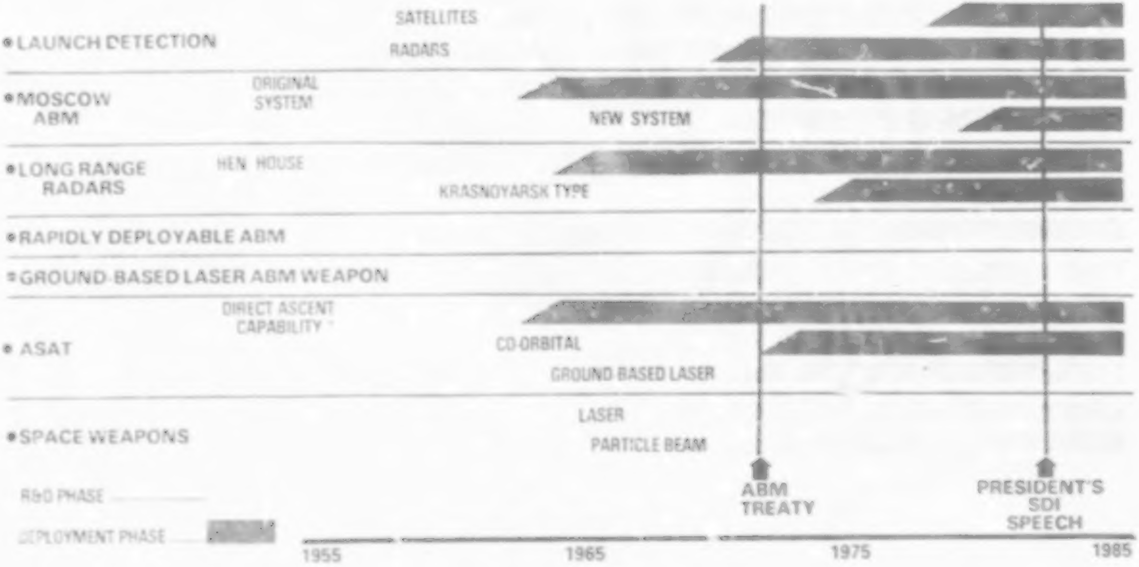
## SOVIET ABM/SPACE DEFENSE PROGRAM



POTENTIAL CAPABILITY OF THE MOSCOW ABM SYSTEM *

268

# ARMS CONTROL OVERSIGHT

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HOUSE OF REPRESENTATIVES, COMMITTEE ON ARMED SERVICES, SPECIAL PANEL ON ARMS CONTROL AND DISARMAMENT OF THE PROCUREMENT AND MILITARY NUCLEAR SYSTEMS SUBCOMMITTEE,

*Washington, DC, Thursday, October 31, 1985.*

The panel met, pursuant to notice, at 10 a.m., in room 2212, Rayburn House Office Building, Hon. Beverly Byron (chairman of the special panel) presiding.

## STATEMENT OF HON. BEVERLY B. BYRON, A REPRESENTATIVE FROM MARYLAND, CHAIRMAN, SPECIAL PANEL ON ARMS CONTROL AND DISARMAMENT OF THE PROCUREMENT AND MILITARY NUCLEAR SYSTEMS SUBCOMMITTEE

Mrs. **BYRON.** Good morning, Admiral Gayler, good to see you again.

Admiral **GAYLER.** Thank you.

Mrs. **BYRON.** We had an interesting time together in Houston at one period.

The panel this morning continues its hearings into the military applications of certain arms control proposals.

To date, the panel has held several days of formal hearings and informal briefings on existing arms control agreements and has also had the opportunity to review the several proposals and counterproposals that have been made by the United States and by the Soviet Union.

In addition to those hearings, several members of the panel had the opportunity to meet with U.S. negotiators in Geneva and Vienna. We also had the opportunity to discuss arms control problems with several ambassadors representing other NATO countries at the MBFR negotiations in Vienna.

On behalf of the panel, I had invited several witnesses representing groups and points of view that are independent of the Government. Among those invitees were Ambassador Gerard Smith, Dr. Harold Brown, and others. Today, we are fortunate to have the opportunity to hear from two distinguished witnesses, Dr. Albert Carnesale, academic dean of the John F. Kennedy School of Government at Harvard University, and retired Adm. Noel Gayler of the American Committee on East-West Accord.

Following today's hearing, I intend to direct the staff to begin drafting the panel's report for calendar year 1985. I would hope that the report can be completed and printed by the first of December.

On behalf of the panel I want to welcome our witnesses today and I recognize Mr. Mavroules to introduce our first witness.

## STATEMENT OF HON. NICHOLAS MAVROULES, A REPRESENTATIVE FROM MASSACHUSETTS

Mr. MAVROULES. Thank you very much, Madam Chairman.

I had hoped I would have a background on both the individuals here this morning. I have that on only one, so I will be delighted to give you some background on Dr. Carnesale.

He is a professor of public policy and academic dean of the Kennedy School of Government at Harvard University. He is a nuclear engineer and was a member of the SALT I delegation. He also headed the U.S. Government delegation to the International Nuclear Fuel Cycle Evaluation, a 66-nation study of the relationship between nuclear power and the proliferation of nuclear weapons.

His recent writings have centered on issues relating to ballistic missile defense, which is of great importance to this panel. Certainly his comments on strategic defense initiatives should be most interesting.

Mr. Carnesale is neither a hawk nor a dove. I believe he considers himself an owl, and I am sure he will be interesting. I want to welcome my friend from New England and thank him very much, along with Admiral Gayler, for being with us this morning.

Mrs. BYRON. You may proceed.

## STATEMENT OF DR. ALBERT CARNESALE, ACADEMIC DEAN, JOHN F. KENNEDY SCHOOL OF GOVERNMENT, HARVARD UNIVERSITY

Dr. CARNESALE. Not completely. I spent 5 years in Baltimore working for the Martin-Marietta Corp. as a nuclear engineer. I was fresh out of undergraduate school. I had decided not to go to graduate school and had grades consistent with that notion. Since then, somehow, things have changed.

What I would like to do first this morning is to spell out a few areas that I think I know something about, and might be able to respond to questions about.

One area is—I thank Congressman Mavroules for the plug—a new book that my colleagues and I have produced, called "Hawks and Doves and Owls, an Agenda for Avoiding Nuclear War." It is unusual among the books written by academicians in that the final chapter has some recommendations for what to do. Each recommendation is a simple declarative sentence that begins either with the word "do" or "don't." So I do have a list of things I would be prepared to discuss that I think can meaningfully contribute to reducing the risk of nuclear war. This, after all, is what we are really trying to do.

The second area is verification of arms control agreements: Existing agreements, possible future ones, and also in a broader sense. What is it about? What should we be trying to do in the field of verification?

The third area, Madam Chairman, is one that you just mentioned: Future directions for strategic arms control.

And the final one, on which I will make some opening remarks this morning, is the strategic defense initiative, including its relevance to the broad area of arms control.

### STRATEGIC DEFENSE INITIATIVE

On the strategic defense initiative, I would like to be somewhat provocative, and to use caricatures to describe the views that are held. Unfortunately, perhaps, the caricatures represent the actual views expressed by most of the people engaged in the debate.

I have a list of 10 basic questions on the strategic defense initiative.

First, what is it?

Second, what is it for?

Third, would it work?

Fourth, what would it cost?

Fifth, what would the Soviets do?

Sixth, What about our allies?

Seventh, what does it have to do with arms control?

Eighth, how would it affect the risk of nuclear war?

Ninth, what do ethics and morality have to do with all of this?

And 10th, all right Carnesale, what would you do?

Mrs. **BYRON**. That was my first one.

Dr. **CARNESALE**. Well, I will try to be brief. I am prepared to go into depth on any of the questions if any members of the committee would like, but I would like to characterize the issues first.

First, what is the strategic defense initiative? The President in his speech, with which we are all familiar, treated it at four levels. First, he questioned deterrence by threat of retaliation: Would it not be better to save lives than to avenge them? This is the oft quoted line—to which the answer is clearly, yes, it would be better to save lives than to avenge them. It is a reasonable question to ask. It reflects frustration with the current situation in which we have no way of saving American lives and the Soviets have no way of saving Soviet lives.

Second, he asked a rhetorical question. What if we could intercept and destroy ballistic missiles before they reach our own territory or that of our allies? Again, the answer is yes, that would be very nice. But it is a rhetorical question.

Third, he set a goal. That was to conduct a long-term research and development program.

And finally, he framed a vision: To render nuclear weapons impotent and obsolete.

We should recognize that the vision is not the issue. That is not where the argument is. I know of no Americans who prefer vulnerability to invulnerability. None. Too often the issue is framed as a choice between being vulnerable or invulnerable, with the suggestion that those choosing to be invulnerable ought to be in favor of spending $26 billion on this program. I think this is a distortion of the real question.

The second thing about the strategic defense initiative to keep in mind is that it deals only with defense against ballistic missiles; not against cruise missiles, not against aircraft, not against fishing trawlers, not against Soviet warheads that might now be buried in cemeteries in each of our 100 largest cities. Why would the Soviets bother to bury warheads in cities when they can get them here so easily by ballistic missiles? They wouldn't. But suppose they couldn't get them here on missiles? Anybody who claims to know how to find out if the Soviets have two warheads buried in cemeteries in each of our cities now ought to work on verification of arms control agreements. That is somebody who knows something that the rest of us do not.

The strategic defense initiative cannot promise invulnerability. The President did not pretend that it did. So what is it that has been caricatured by the left as a quest for invulnerability which cannot be achieved, and by the right as a quest for invulnerability that ought to be achieved? This leads to the next question on my list.

Second question: What is the SDI for? Here again, the President and the Secretary of Defense have been consistent. The President talks about it as a system intended to transcend deterrence by threat of retaliation. When asked the question, Is this system to defend missiles? he said No, this is a system to defend people and to destroy missiles. That is what the President said when asked that question directly. Similarly, Secretary Weinberger talks about a system that is to be thoroughly reliable and total.

Others in the organization talk about more traditional military objectives. Some talk about bolstering deterrence by protecting our retaliatory forces, or by complicating a Soviet first strike. Others talk about limiting damage to the Nation, should the Soviets attack. Still others talk about the SDI as a means to influence Soviet behavior, for example to discourage expanded Soviet deployment of ballistic missile defense, or to encourage them to reduce offensive forces.

A perfect system would do all of these things, but we are not talking about a perfect system. It is going to be difficult to come up with a system that transcends deterrence by rendering nuclear weapons useless and, at the same time, enhances deterrence by assuring the ability of nuclear weapons to destroy the adversary in a retaliatory attack.

Also, because a strategic defense would likely be more effective against a second strike than a first strike, we get another difference in the views of the left and the right.

To the left the strategic defense initiative is part of a first strike strategy. To the right, it is to deter the Soviets, and particularly to deter a Soviet first strike.

My third question is: Would ballistic missile defense work? Obviously that depends on what it is for. What targets is it supposed to defend? How well? Against what threat? With what technology? And against what countermeasures?

So the answer to "Would it work?" is "Nobody knows." We could defend some of our command, control, and communications facilities, and some of our retaliatory weapons. We know how to do that. The question is whether or not it would be cost effective. It is not a question of whether or not it is possible. It is possible.

As for defending our cities, I think it would be useful to move away from the nationalistic perspective for a moment. Suppose we form two teams: team A and team B. Team A has an enormous country with about 100 major cities in it, and has the job of ensuring that team B, which has about 30,000 nuclear weapons, can't get any of them to team A's cities.

Team B has about 30,000 nuclear weapons, and its job is to get some of them to team A's cities. I don't know anybody who would bet on team A to win this contest. But, if you say team A is the Americans, and team B is the Russians, you change the picture substantially. Americans would then bet on team A. This is the wrong way to ask the question of whether the SDI would work.

Without knowing what the SDI is supposed to do, what the technologies are, what it is supposed to defend, and how well, the left says it won't work. And the right, in the same state of ignorance, says of course it will work.

## COST OF SDI

Fourth, what would the SDI cost? I won't take you through the full litany again. We don't know what it is supposed to defend, or how well, or with what technology. What would it cost? The answer is, I don't know. Nobody knows.

The left says, we don't know what it would cost, but it is too much. And the right says, we don't know, but it is worth it.

Fifth question: What would the Soviets do? It is important to keep in mind that the Soviets already do a lot. They have had a major strategic defense program for decades. It is a very, very active program, including research, development, field testing and actual deployments. They do a lot. We can pursue this further if you wish.

What would they do in response to an American program? Aside from rhetoric, of which there would be a great deal, and of which we have already seen a great deal, they would probably do what we would do if we saw a Soviet defense that caused concern. The most important thing for them to do would be to ensure that their weapons could penetrate our defense. So they would probably try to deploy some penetration aids. They might also deploy more MIRV's, maybe harden their boosters, maybe deploy more boosters.

They might try simply to get around the ballistic missile defense system by deploying more cruise missiles. They probably would expand their own ballistic missile defense, if only for political reasons. That is probably what we would do if they expanded their defense.

If the Soviets were to respond to our defense by expanding their own, then more of our weapons would survive a first strike, but the surviving weapons would then have to penetrate a meaningful Soviet defense. It is not clear how that tradeoff would come out.

Here I find the most interesting dichotomy between the left and right. The left adopts a pure action-reaction model. The poor Soviets, says the left, won't do anything, as long as we don't do anything. We ought to stop and the world will be safe.

The right has an equally absurd model. They maintain that there is no connection between what we do and what the Soviets do. The Soviets are just going to do their thing and, therefore, we might as well do ours.

Now for my sixth question: How would our allies react? We have gotten many reactions to the SDI from our allies, most of them somewhat knee-jerk in nature. They offer at least 100 reasons why they don't like the SDI; 95 are variations on one theme: It would change the status quo. The allies don't like to change the status quo.

The status quo to them is no war. They see all those bad guys over there, to the east, with lots of nuclear weapons and lots of conventional weapons, and notice that they are not being used. If the Americans want to change the situation in Europe, the burden of proof is on the Americans. If we want to put more troops into Europe, the allies don't like it. If we want to take troops out, the allies don't like it. If we want to put more nuclear weapons in, or take some out, the allies don't like it. They like the status quo.

There are five more reasons why they object to strategic defense. The French and British worry that if we are going to have extensive defenses, so are the Soviets. What effect would this have on their independent deterrent forces, which are much smaller than ours?

The Europeans worry that if the Soviets have strategic defense they may adopt a more adventurous foreign policy. They worry also that if the United States has a strategic defense, we may adopt a more adventurous foreign policy. And they worry that if both superpowers have strategic defense, we might both be more adventurous.

The final European concern is about where the SDI dollars will come from.

I don't think you can read much into public statements by political leaders of the allied countries. Even if a leader of an allied country thought this was a crazy idea, he or she could not possibly say so. First of all, this is the President's initiative. He is very fond of it.

Second, it has a lot of public support.

Third, if you are an ally, you don't want to be in the position of telling the American people that you want them to be vulnerable rather than invulnerable. That is not a wise political position to take.

Fourth, your guess is that a lot of money probably will be spent on this program, whether you like it or not, and you might want to get some of those bucks. And this may involve important new technologies. You want to take part in that.

Most of the leaders, as we see, are meeting both their domestic political needs and the President's wishes by saying that their governments will not participate in the SDI but their companies are welcome to participate. This way they get the advantages of the SDI without taking the political flack.

On the question of allies' views, the left says that the allies don't like the SDI and they shouldn't. The right concedes that the allies say they don't like it, but attribute it to political pressure. Once they understand the SDI, the right believes, the allies will come to like it.

### SDI EFFECT ON ARMS CONTROL

Seventh question: How would the SDI affect arms control? I know this is a subject that is of particular interest to this committee.

Until recently, it was clear that the SDI program was on a collision course with the ABM Treaty, because the ABM Treaty—it would have agreed up until 3 weeks ago—clearly prohibits any development, testing, or deployment of space-based ABM systems or components.

Recently this interpretation has been called into question. The issue is not so much what the ABM Treaty says, but whether or not the Soviets in years past interpreted it as we have. The administration is in the rather odd position of saying it knows that the Soviets thought something other than what the Soviets tell us they thought.

But in any event, deployment of space-based systems is a clear violation of the ABM Treaty. There now appears to be some question about whether you can develop or test exotic space-based components.

The administration says it will adhere to the stricter interpretation for now and will not develop or test space-based components of exotic types. It remains to be seen how this will play out.

In my view and, from everything I have read, in the Soviet's view, and certainly in the U.S. view for the past 13 years, minus about 3 weeks, development, testing, or deployment of any space-based systems or components would be a violation of the ABM Treaty.

What about reductions in offensive arms? The left says that if the United States builds defenses, the Soviets will want more offensive arms. The right says the opposite will happen.

I believe there is an analogy that helps explain why these people think the way they do—the Laffer curve of supply side economics.

Everyone agrees that if the tax rate is zero, the Government gets no revenue. Everyone also agrees that if the tax rate is 100 percent, the Government gets no revenue. And they agree that there is a curve in between that goes up and comes back down. The big argument is over which side of the peak we're on now. If we increase the tax rate, will revenues go up or will they go down? On this, people disagree.

If you believe defenses are going to be extraordinarily effective, then you are likely also to believe that the Soviets will not react by escalating. It is reasonable to assume that they would be willing to reduce their offensive weapons if our defenses are extraordinarily effective. If, however, you imagine defenses that are only marginally effective or moderately effective, it is reasonable to expect the Soviets to respond with increased offense.

If you are an extraordinary optimist about defenses, you believe they induce reductions. But if you are not an extraordinary optimist about defenses, you expect them to lead to the building of more offensive weapons.

Let me mention one other thing about the SDI and arms control: Sharing technology with the Soviets. When Mr. Mondale was trying to get to the right of Mr. Reagan in the debates, Mr. Mondale said of the SDI: This technology won't work and it is too important to share with the Soviets. Mr. Reagan said, this technology will work, and we should share it with the Soviets.

Suppose you were to ask any engineer, what would most help him to beat the defensive system of the other side. His initial response probably would be, money. But after that, he would say, the technology. He would want the technology of the defensive system.

So, on its face, the notion of sharing the technology is absurd. My compromise for the Reagan and Mondale debate is this: If the technology works, don't share it. If it doesn't work, share it.

How will the SDI affect arms control? The left says it is a disaster for arms control. The right says it is the great new hope for arms control.

Now for my eighth question: How would the SDI affect the risk of nuclear war? If what you mean by risk is the possibility that we can literally destroy the Soviets' society and they could destroy ours, the SDI probably could not affect the risk much. If it defends only against ballistic missiles, and if it doesn't defend our cities, then the Soviets would still be able to destroy our society.

The question is, What will it do to the likelihood of such an attack? The strategic defense initiative, even if it works perfectly, doesn't eliminate the possibility of such an attack, but it may alter the likelihood. That is where the argument ought to be. And people have been arguing for a long time about whether defenses make things better or worse.

I don't have a simple answer for that. But the left has a simple answer. They say they know enough about SDI to conclude that it increases the risk of nuclear war. And the right offers an equally simple answer. They don't have to know any more about SDI to conclude that it decreases the risk of nuclear war.

My ninth question is about ethical considerations: Defense clearly has intuitive appeal to all of us. None of us picks American vulnerability over American invulnerability. But that is not the issue.

### MUTUAL ASSURED DESTRUCTION

What gets attacked most often in these discussions is mutual assured destruction [MAD]. Mutual assured destruction is something nobody likes. It is not our doctrine. Certainly there are many of us who like assured destruction, but I don't know anybody who likes mutual assured destruction.

I like the powerful deterrent inherent in the ability of the United States to destroy the Soviet Union. I don't like the idea that the Soviet Union can destroy the United States. But that happens to be the current situation.

When we are offered the alternative of mutual assured survival, I like the prospect of assured survival for us. But that is an aspiration.

Comparing the current reality with an aspiration, it is easy to say I prefer the aspiration. But is that aspiration achievable? How dangerous is it to try to achieve it? These are what the questions ought to be.

On the matter of ethical considerations, the left says the SDI is a disgrace and a cruel hoax. The right says it is a moral imperative to get away from MAD.

Finally, Madam Chairman, I get to your question: Carnesale, what would you do?

Mrs. **Byron**. That was my first question.

Dr. **Carnesale**. Finally, I get to your question. The first thing to do is to move beyond the polarized debate.

There is no information in the caricatured views I have offered that would help you make a decision about the SDI. Yet that is the nature of the public debate thus far.

Second, we should recognize that the question is not do I spend zero or do I spend $26 billion over 5 years; it is how much do I spend and on what?

My personal view is that $26 billion is too much, for two reasons: One is that I think any program that grows that rapidly is bound to be wasteful. The other, more important reason, is that the political momentum of such a program would be unstoppable.

I can't imagine that, at the end of 5 years and $26 billion, or at the end of 10 years and $70 billion, we would say, well, we looked hard but didn't find anything, so we won't deploy anything. I think there would be enormous pressure to deploy something, even if we hadn't found anything worth deploying.

Even more important is how the Soviets would react to a $26 billion program. Can they watch this program and assume that the Americans are going to go for 5 years and stop? No.

I would assume we would not stop. I suspect most of you would assume that if we spent $26 billion, we would do something. They would have to as well.

How much would I spend? About $12 billion to $15 billion, which represents roughly what we planned to spend as of March 22, 1983. This would be an average of $3 billion a year over the 5-year period—which represents a substantial increase over the $1 billion per year spent under President Carter.

I also would spend it differently. I would devote a bit more of my resources to field testing some of the more conventional kinds of systems that could actually be deployed. The reason is, if the ABM Treaty were torn up today, the Soviets could make use of their production lines. They have components they can deploy. We have an idea. Five years from now, they could have a lot of stuff all over the Soviet Union. We might be almost ready to deploy our idea. That would be a bad outcome.

It is not good for them to have that kind of lead-time advantage. I would reduce it by focusing less on the exotic systems and more on some of the things you might have to deploy.

The Soviets could tear up the treaty tomorrow. It may not be our choice.

Third, as part of an arms control framework that I think could be achievable in the near future, perhaps at the summit, I would reaffirm the ABM Treaty. Let me say briefly what my package would be so it doesn't sound like a mystery.

We must recognize that it is unreasonable to expect a tradeoff whereby the Soviets give something on offense in return for our saying that we will abide by the ABM Treaty that we already signed and ratified.

It would not be unreasonable to expect the Soviets to agree to an offensive agreement that they might not otherwise be interested in because of the fear that we might move out of the ABM Treaty. I think this gives us leverage, but not a bargaining chip. We can only trade defense for defense.

We might get an agreement on the offensive side that calls for reduction of SS–18's that we might not be able to get otherwise.

On the defense side, in reaffirming the ABM Treaty, I would call for our negotiators to clarify four areas. The first area is large phased-array radars, such as the one under construction at Krasnoyarsk. This relates also to the recent fuss about Thule and Fylingdale.

The second area is dual purpose systems; in other words, non-ABM systems with ABM potential. An example is the Soviet anti-tactical ballistic missile systems about which we are concerned.

The third area would be the distinction between permitted research and prohibited development and testing.

And the fourth area would be to define more precisely what is meant by a component of an ABM system. This is needed to clarify the prohibition on development and testing of ABM components.

On the offensive side of the framework, I would try to pick as many reasons from the Soviet proposals as I could, including the 50-percent reductions. I would try to limit to no more than 50 percent the number of warheads on any one leg of the triad, particularly the ICBM leg.

I would certainly be sure that they went back to accepting our definition of offensive strategic weapons. It does not include forward-based systems. We have gotten them to agree before; we could get them to accept our definition again.

That would be my package to accompany concurrent negotiations continuing on intermediate-range nuclear forces.

The fourth thing I would do, for reasons I stated before, would be to prepare to counter possible Soviet deployment of ballistic missile defense. After all, they could choose to tear up the treaty tomorrow and start deploying.

We know how to penetrate the kinds of systems they could deploy. Have we produced and stockpiled suitable penetration aids? The answer is no. I would do more of that than we currently do.

The last item on my list in this context is this: Stop bad-mouthing deterrence. I would fortify it rather than undermine it.

What is the weak link in our deterrent? It is not our capability. There isn't anybody that maintains that we can't destroy Soviet society today. It is the credibility of that deterrent that is doubted by some.

Everybody agrees that deterrence is a lousy system, that we want to move beyond it. Unfortunately, it is the best system we have now.

The left has a magic solution: Make the nuclear weapons go away; disarmament. The right also has a magic solution: Render them impotent and obsolete; build a perfect shield.

Neither of those magic solutions helps deal with the problems we are going to be facing in the decades ahead. They are both worth thinking about, worth pursuing, worth trying to bring about.

But for now, deterrence is what we rely on. It may be a fragile shield, but before we discard it, we ought to recognize that it is the only one we have.

I will quit there.

Mrs. **Byron**. Thank you very much.

Admiral Gayler, do you want to go ahead with your testimony and we will ask questions of both of you at the same time.

## STATEMENT OF ADM. NOEL GAYLER, USN (RETIRED), AMERICAN COMMITTEE ON EAST-WEST ACCORD

Admiral **Gayler**. Thank you, Madam Chairman.

I want to say, first, that I think that Dr. Carnesale's exposition is brilliant. He is an owl. You don't need to see his ear tufts to see that.

I agree with 99.44 percent of what he said. Amusingly enough, when we were talking before the hearing started, we discovered that we each wanted to talk about precisely the same subject. We see the problems in terms of the same problem here.

I think the only area where I would possibly disagree is that there is any prospect at all that the strategic defense initiative can work in any of the senses that he talked about, and that is for a long variety of technical reasons as well as because science works for both sides. This is not a one-handed game in which we are working against some moon, or something like that, but a two-handed game.

While in most of the relevant technologies, for example, the Soviets have no supercomputers, and strategic defense would require super, super, supercomputers of the kinds not even imagined yet, still historically they catch up in 3 or 4 years and the situation goes back where it was.

### VERIFICATION

I would like to talk briefly about verification. I think that we can verify any violation of an arms control treaty with the Soviets that would make a difference in the outcome of a nuclear exchange between us. That is because on the basis of my experience in targeting, and analyzing the results, I have discovered that the results are very insensitive to the numbers involved on either side, or to the technology. So that violations would have to be so massive that I can say with confidence we would find them.

I would like to remark that I hope that in our negotiations with the Soviets we keep our eye on the ball. The ball, in this case, is to reduce the risk of nuclear war, not to look better in European public opinion or domestic public opinion. However important that may be, it is secondary to survival.

Dr. Carnesale uses a method of, on the one hand, these people say this; on the other hand, these people say that. I will not do that. I have a strong feeling that the security of the United States is dependent on reducing the risk of nuclear war, and in no other way can we assure it, and that there is a straightforward way to do that.

So, without further adieu, I would like to go through the set of proposals that we have to reduce the risk of nuclear war, taking it as given that the consequences are intolerable, taking it as given that to do that in no way raises the question of red or dead, we need be neither. We can be secure. We are on an island continent with the world's strongest navy, the world's strongest air force, relatively weak and friendly neighbors to the north and south of us, and nobody can come against us except with nuclear weapons, and that is our security and our military problem.

So we propose a set of comprehensive agreements which recognize, first, five fundamental principles, that these nuclear weapons, so-called, have no sensible military use. I have come to that conclusion from very careful examination in all of the five major threat areas in which the United States might have to engage in combat, and particularly a very careful examination of the Pacific area for which I used to be responsible.

The reason for this is that we are either constrained not to use these because their use only kills people and not military capabilities, or because their use will result in military retaliation against us which will leave us worse off than before.

I will give two examples. If we were to open nuclear war at sea in an attempt, for example, to get an advantage against submarines with nuclear depth charges, then we would find ourselves at a disadvantage because we are the people that have the larger number of big ships, and one nuclear weapon equals one ship. It would be disadvantageous for us to do that.

If we were to attempt to defend Europe by the first use of nuclear weapons, the first thing that would happen would be that a great many noncombatants, in the millions, mostly women and children, would be killed, probably mostly German. That would fractionate the alliance.

The second thing that would happen would be an almost certain escalation. Certainly, the Soviet doctrine would be coming back with more. Whether the escalation went up to final total conflict in one step or two steps or three steps wouldn't make much difference.

And finally, if both of those things were avoided in the European theater, by some set of miracles, we would still be worse off because we, the NATO side, has the smaller number of far more important vulnerable nuclear targets—harbors, air fields, depots—than do the Soviets.

It doesn't make sense in that theater. It doesn't make sense at sea. It doesn't make sense in the Pacific theater.

The second principle is that security against nuclear attack, in my judgment, can't be gained by unilateral action. We cannot go to a defense that will defend populations. We cannot, in my judgment, build a defense that will give us a sensible, appreciable military advantage over the Soviet Union.

## FIRST STRIKE

I would like to talk about first strike, disarming first strike. There is a tendency to talk about that in terms of the capability, imagined or otherwise, to destroy the Minuteman fields. But most of our retaliatory weapons, as is well known, are in submarines, and the submarines are not to be attacked by that way.

Parenthetically, the recent security disclosures by the Walker spy ring, in my judgment, will not affect the ability of our submarines to remain undetected, our ballistic missile submarines. That is not an off-hand opinion; I have looked into it.

Nor can we get security, in my judgment, by any set of gadgetry, whether it be the strategic defense initiative or the MX system or any other such systems in which we attempt to gain a technological edge of significance over the Soviet Union.

The third point I would make is an obvious one in this audience, and that is that political will on both sides is necessary to reach a solution. Given political will, however, there are no important political or technical or security obstacles to settlement.

The fourth point I would make is that however unhappy and disgusted we may be, or even concerned with Soviet behavior in other fields, this should not be linked to our own self-interest in reducing the risk of nuclear war. So that nuclear agreements should not be linked to other issues.

I take as an historical example the failure to ratify SALT II, which was in some degree influenced by the discovery—as a matter of fact, we have known it for a long time—of a brigade of Soviet troops in Cuba. Plainly, that had nothing to do with the problem.

As a military man, I will say if you had that many troops someplace, you would want to organize them in a brigade or couple of regiments or something, and not just a gaggle. They would have been far more dangerous had they been organized into penetration teams for South America.

But the point I am making is that it was an extraneous issue, and one which we should not let extraneous issues get in the way of our security against nuclear attack.

Finally, a point that I have already made, which is, in my judgment, verification to the extent needed for security is feasible and practicable.

I will answer the question, Madam Chairman, you asked Dr. Carnesale: What would you do about it? What would I do about it? There are eight actions toward a general nuclear settlement with the Soviet Union.

## ACTIONS NEEDED FOR A GENERAL NUCLEAR SETTLEMENT

The first is a political idea. It is that we simply drop the intemperate and insulting, threatening language that we use toward each other. Not only does such language poison the negotiations, but the mindset that is generated that way may enhance the risk of nuclear war.

I was a serving officer in the Navy when we went to war with Japan, through the Japanese attacks on us. But it was well known among us all that in the next few years we were going to war with Japan. The mindset had been generated.

The mindset had been generated even more, we know, through many others on the Japanese side, that they were going to war with us.

If we maintain that mindset with respect to the Soviet Union, we increase the risk of war.

Let me ask you to imagine what would be in the mind of a President, Premier, or commander who could order a nuclear attack and the destruction of tens of millions of people, and invite corresponding destruction on his own side. He would have, I think, to be terribly afraid. He would have to believe that the people he was about to destroy are somehow less than human. And he would have to believe that there was no alternative to the terrible thing he was about to do.

Now, mindsets of that kind are not generated in a short length of time; they are generated over the years. This is why it is extraordinarily important that we drop this kind of rhetoric toward each other, that sort of unfocused, undirected enmity.

The second thing I would propose is that each side abandon nuclear war fighting doctrines. Both the first use or tactical use and counterforce are dangerous and inherently destabilizing. Control of a protracted nuclear war is both illusion and threat.

In my judgment, there is no prospect whatever of effective control by our national command authority, or by the corresponding Soviet entities, of what goes on after any kind of a nuclear war is started. It will play itself out of control.

The third is that I believe that we should not narrow, but broaden, exchanges of every kind with the Soviets, including improved civil and military communications. I particularly think that we should lose no time in updating modern communications between military staffs and between foreign secretaries and the Secretary of State, and the President and the Premier should be able to talk to each other on secure television, which is certainly technically feasible at the present time.

Trade is an important means of communication. It has major economic importance particularly to those of our people like the Farm Belt where the Soviets are mainly or a potential market. But it also has important political content. Lots of contracts are executed with different people in a way which can build confidence in carrying out agreements.

Technical exchanges, so long as they don't impinge on the military field, can be of advantage of both sides, and people-to-people exchanges.

Let me tell you, if you have, as I have, attended a Sunday service at a cathedral outside of Moscow and seen 6,000 communicants standing to worship in the Christian theology, it is very difficult to suggest that the Soviet Union is a totally Godless place.

An interesting sidelight is that Soviet officials, when they take you sightseeing, don't show you anything that the Communists have done. They show you the old monuments.

Mrs. **Holt**. May I just ask a question?

When you attended that church, weren't those parishoners old ladies and the priests, very old, old priests, who on their death will not be replaced, and you saw no young people there at all?

Admiral **Gayler**. No; that was not my experience.

Mrs. HOLT. That has been my experience——

Admiral GAYLER. I would say——

Mrs. HOLT [continuing]. In every church that I have been in in the Soviet Union.

Admiral GAYLER. The bishop was a man, I would say, in his late thirties or early forties; very vigorous. There were a lot of old people. If I were to guess, I would say the population of the church was about like it is in churches in this country; generally speaking, older people, and then the average of the population, about the same.

So much for exchanges.

The next thing I would do would be to declare a mutual renewable moratorium at the head of government level on the developing, testing, or deployment of new nuclear weapons systems. From a military standpoint, we need new nuclear weapons systems like a hole in the head.

There is no reason known to me why, even if we go forward with systems like Minuteman, that new nuclear weapons need to be developed either to improve the yield-to-weight ratio or for any other purposes. The one we have, the devices we have, are plenty good enough for the destruction of any enemy.

The other reason for continued testing, which is adduced, is to check the reliability of the stockpile. The information that is available to me suggests that we do that by other means on a routine basis, and that testing to the point of the explosion of the nuclear device is not necessary for that purpose.

If we were to have a mutual renewable moratorium, then we would put a stop to one aspect, the technical aspect, of the nuclear arms race on both sides.

The next thing I would suggest is that we remove the shorter range nuclear weapons from effective range of each other by establishing nuclear weapons-free zones.

The other night, a man who had been a tank commander during the time of the Soviet invasion of Czechoslovakia, on the Czechoslovak border, took me aside and told me of the extraordinary concerns he had as the custodian of a nuclear weapon stockpile in the battle situation that obtained then, when it could have been overrun, or he could have had on his shoulders the responsibility for initiating use of tactical nuclear weapons.

It is generally known that there are about 7,000 such weapons around Europe. We safeguard them to the best of our ability. But banks get robbed, and it is not impossible that some of them can be hijacked and find their way into the hands of terrorists.

Incidentally, I think picking up a weapon in that way is far more a threat from the terrorist standpoint than that some bright graduate student will build one in his basement. Getting hold of the material is going to be a problem for him, and he will probably irradicate himself before he finishes.

I have personally seen, when I was CINCPAC, two instances where nuclear weapons were not, in my opinion, properly safeguarded, in the sense that they could have been gotten out by a commando team who had information as to their location. It is a very dangerous situation to have so many weapons around.

The next proposal I would make is both sides put space off limits to future space systems and weapons systems, including specifically antisatellite weapons and attempted ballistic missile defense.

The reason for that is primarily that space is more important militarily to the United States than it is to the Soviet Union. It has a lot to do with geography, it has a lot to do with our greater dependence on command and control, it has a lot to do with the electronic security of the fleet, which in my opinion can only be achieved by making use of space assets, and it has particularly to do with the difference between the nature of our open society and the Soviet closed society.

We simply gain from space a great deal of intelligence on what goes on in the Soviet Union that is frequently available to them in this country for the price of subscriptions to technical journals and, as a matter of fact, congressional hearings.

The next point that I would make is that we should develop broad and effective methods for cooperation of the superpowers and nuclear weapon states to inhibit the spread of nuclear weapons worldwide.

I really don't worry as much about an irresponsible Soviet use or threat of nuclear weapons as I do about such weapons in the hands of Qaddafi and Khomeini, and even less responsible people.

I think that a necessary, possibly not sufficient, but a necessary condition toward inhibiting the spread of nuclear weapons worldwide is strong Soviet/American cooperation, very much in the interest of both of us in this field, particularly in intelligence, but also politically and also in inhibiting the transfer of technology.

And finally, I would like to talk about this a little bit more, institute a process, and the key word here is "process," for deep and continuing cuts in nuclear warheads and weapons grade nuclear material. Let me tell you why "process."

In the past, and as far as I know currently, we are attempting to negotiate with the Soviets a future state of affairs which both sides will agree is fair, which both sides can define and which both sides will agree is verifiable. We have had great difficulty in all three of these things, in trying to reach arms control agreements.

I think a process by which both sides deliver nuclear weapons to a central depot, run by both sides, examine them for their weapons grade nuclear content, turn over that content to a plant run by both sides, and there denatured with natural uranium from 80 percent plus, which is weapons grade, to 3 percent, on the order of that which is powerplant grade, and made available for burning up in powerplants. The weapons themselves are without intrusive inspection, ground up to sand-size particles. A process like that, instituted with perhaps 10 weapons on each side, which nobody could claim was a threat to anybody's security, building up on a typical industrial growth curve, to something like 1,000 weapons a month. In a period of 4 or 5 years there would simply not be sufficient nuclear weapons to carry out the nuclear warfighting doctrines of tactical nuclear war, or of counterforce. One can imagine that both sides would first turn in their cats and dogs that they didn't care much about anyway, then in their own interest they would turn in their more vulnerable weapons, and one could believe, I think with reason, in the end both sides would reserve to themselves their

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least vulnerable weapons. We could let the process run until we had reached that minimum invulnerable deterrent against nuclear war, which is not perfect, you cannot uninvent these things, but you can certainly make the situation far safer than it is now.

At the same time, you prohibit and inspect the prohibition of replacement weapon grade material.

That is not difficult now, but with the development of new ways to separate out fissile isotopes from natural uranium, ways that are not as observable as the huge gaseous defusion plants, it may be more so. But without going too much into the intelligence involved, I think it is reasonable to believe that those alternative ways, at a scale sufficient to make any difference, would also be observable.

So now I suggest that we undertake in our negotiations with the Soviets the recognition of two basic common interests, that we not be blown up and that we not see nuclear weapons spread around the world in irresponsible hands.

I think that agreement on proposals of this kind will enhance the security of each of us, and of the world, that it will dramatically reduce the risks of nuclear war and that the improvement in the political climate between us, which will be inevitable, will in turn reduce the risks of war of any kind.

Thank you very much.

[Admiral Gayler's prepared statement follows:]

## PREPARED STATEMENT OF ADM. NOEL GAYLER

### EPITOME—A GENERAL NUCLEAR SETTLEMENT

### *I. Introduction*

The extreme consequences of nuclear war are now so well recognized that action must shift from description to prevention. To forestall nuclear war will require coordinate work in the political, diplomatic, military and weapons areas.

The American Committee on East-West Accord proposes a comprehenisve plan: a set of five fundamental principles and eight actions. Each action has stand alone-value. They can be carried out together, or separately, in any order. But each powerfully reinforces the others. Together the eight actions constitute a general nuclear settlement with the Soviet Union, to be joined proportionately and at the appropriate time by the other nuclear powers.

### *II. The principles*

The plan recognizes five fundamental principles:

Nuclear weapons have no sensible military use, since their consequences always recoil terribly on the user.

Security against nuclear attack cannot be gained by unilateral action. Cooperation of the adversaries is essential.

Political will on both sides is necessary to reach a solution. Given political will, there are no important political or technical or security obstacles to settlement.

Nuclear agreements must not be linked to other issues.

Verfication of nuclear arms agreements, to the extent required for security, is feasible and practicable.

### *III. The actions*

Coordinate actions of a general nuclear settlement are eight:

Each side drop intemperate, insulting and threatening language used toward the other. Not only are negotiations poisoned by such rhetoric, but the mind-set so generated may enhance the chance of war.

Each side abandon nuclear war-fighting doctrines. Both first or tactical use and counterforce are dangerously and inherently destabilizing. Control of protracted nuclear war is both illusion and threat.

Abandonment of war-fighting doctrines and would shortly be followed by observable changes in development, procurement, deployment and exercises: real-world consequences.

Broaden exchanges of every kind, including improved civil and military communications.

Declare a mutual, renewable moratorium at the head-of-government level, on the development, testing or deployment of new nuclear weapons systems.

Remove shorter-range nuclear weapons from effective range of each other, by establishing nuclear weapons-free zones.

Both sides put space off-limits to future space weapons and weapons systems, including specifically antisatellite weapons and attempted ballistic missile defense.

Develop broad and effective methods for cooperation of the superpowers and the nuclear weapons states to inhibit the spread of nuclear weapons worldwide.

Most centrally, institute a process for deep and continuing cuts in nuclear warheads and weapons-grade nuclear material. This process had three major elements:

U.S. and USSR turn in continuously equal numbers of nuclear warheads of their respective choice, and jointly convert their fissionable material, at an agreed site, to nuclear fuel for burning in power plants. Destroy under joint supervision, non-nuclear components.

U.S. and USSR cease production of weapons-grade fissile material.

U.S. and USSR agree to full-scale safeguards to prevent diversion of spent fuel from power plants to weapons use.

These proposals for the destruction of weapons address an equal process of reduction, rather than an end state to be negotiated. They treat the weapons themselves, together with the nuclear material, rather than the infinitely complex delivery systems.

*IV. Analysis*

To be basically negotiable, any proposal should be definable, equitable, verifiable (to the degree necessary) and it should contribute to the security of each country. All of the proposals meet these tests.

In addition, they break new ground in a way that promotes general political acceptability, both within nations and between them. With some exceptions, they require neither side to recede from positions previously taken. They can also support agreements negotiated within a different conceptual framework, whether already in place or in the future.

The basis for agreement is that the U.S. and the Soviet Union have two overriding interests: avoiding destruction and avoiding nuclear proliferation.

Agreement on the proposals will enhance the security of each signatory and of the world. It will dramatically reduce the risk of nuclear war. The inevitable improvement in the political climate will in turn reduce the risk of war of any kind.

Mrs. **Byron**. Thank you both.

Let me go into a few questions that I have, and then we will turn it over to Mrs. Holt for her opening statement.

Dr. Carnesale, first I was afraid we were going to have to buy your book to read the last chapter before we got your answers on your questions. I am delighted that you gave us the answers to our 10 questions.

As far as the hypothetical with the cemeteries, I will give you back to Boston, you can forget about Baltimore.

Let me ask you what you think the prospects are for this administration to come up with any negotiation on a comprehensive arms reduction proposal before, say, 1988, and I think we have seen some movement with the Russian proposal that was tabled several weeks ago.

Four members of the committee had an opportunity to be in Geneva with our negotiators the day before the proposals were tabled. I understand we have some proposals being tabled tomorrow. Hopefully the talks in Geneva will extend a little bit, which I think is a very good sign.

Would you say that you are encouraged by the administration's positive response to the Soviets' proposals?

Dr. **Carnesale.** Yes, I am encouraged. I think the fact that the administration is working so very hard to reduce expectations for the summit indicates that they feel strong pressures to produce something at the summit. I find that part encouraging.

I find the Soviet proposals, though outrageous in their unfairness, no more outrageous than anybody else's proposals at the start of negotiations.

Mrs. **Byron.** On our other theory.

Dr. **Carnesale.** Do I believe that the Soviet proposal would constitute an acceptable outcome? The answer is clearly no. If you look at our proposals from the Soviet point of view, are those acceptable outcomes? Again, the answer is clearly no. This is not surprising. If you enter into a negotiation and the other party immediately accepts your offer, you are going to have a hard time explaining to your constituents why you went in with a proposal like that.

We should be careful not to expect too much at a summit. Neither the United States nor Soviet delegations could negotiate an agreement at the summit, nor would I want them to. The closest they could plausibly come is to establish some kind of a framework upon which their negotiators can build. The usual reference is to Vladivostok, where President Ford did precisely that. I believe that such a framework is achievable. I gave some indication of that before.

Both Admiral Gayler and I mentioned the verification question, but neither of us addressed it.

Mrs. **Byron.** I think Admiral Gayler said that he thinks we can verify.

### VERIFICATION

Dr. **Carnesale.** If the only test of verification is whether we can be confident that the Soviets cannot get capabilities that would threaten the security of the United States without our knowing about it, I am quite confident we can meet the test. Indeed, we should be careful to realize that arms control agreements cannot solve all of our intelligence problems. If we cannot tell whether or not the Soviets are doing things that threaten the survival of the United States, we are in big trouble, arms control agreement or no arms control agreement. Let's not blame that on arms control agreements.

I believe there is a great deal more to verification. If you talk about arms control anywhere, the first argument made is that you cannot trust the Russians. Does this mean we need better verification? No; if you are going to select agreements solely on the basis of how well we can verify them, you would select agreements that only limited American weapons, because we can verify that very well. Verification is a means to an end, it is not the objective.

This administration has been very strong on verification, and very critical of the verifiability of SALT II. They will not be able to come up with an arms control agreement that could meet the verification criteria that they would have liked to have established for SALT II. Unless they come to view an adequately verifiable agreement as one which is in the net interest of the United States, rather than as one in which you can be positive that the Soviets are not cheating at all, the chances of having an agreement are zero.

Mrs. **Byron**. We have seen the two reports the President has issued on the Soviet violations. How can future arms control agreements, with that in mind, change the repeated violations?

Dr. **Carnesale**. On my list of problem areas in the ABM Treaty—things I would want to discuss with the Soviets—No. 1 was large phased-array radars. That is because of Krasnoyarsk.

I believe that an objective observer, a man from Mars, looking at the data we have on Krasnoyarsk, knowing nothing about arms control agreements, but knowing something about radars, probably would not be sure about what type of radar it is. His best guess would be that it is an early warning radar. If he were told that the Soviets are not allowed to build an early warning radar at Krasnoyarsk, he would ask for more information. It looks like an early warning radar. Even the people in the United States who are rather sympathetic to arms control are not sympathetic to Krasnoyarsk, nor to the Soviets' refusal to be helpful in providing information about this radar. This is an issue that has to be resolved.

Those of us involved in SALT negotiations were able to separate verification from compliance. Verification is the more technical task of telling whether they are cheating and, if so, to what extent. As for what to do if you believe they are not complying, that would be a political problem that would have to be faced; if it were to arise in the future.

I believe that such a situation has arisen with regard to Krasnoyarsk. To talk about improving verification without simultaneously talking about compliance is to say that you want to be able to determine even more precisely the extent of the cheating. without deciding what to do about the cheating.

Based on what I know, Krasnoyarsk looks like noncompliance to me. That is why that is a fundamental issue that must be addressed if we are to make progress.

Admiral **Gayler**. I actually prepared a paper on verification, which I decided not to distribute because I thought you already had enough paper.

Mrs. **Byron**. Would you like to submit it for the record?

Admiral **Gayler**. I would like to do that and if I may, I would like to make four short points from it.

Mrs. **Byron**. All right.

### VERIFICATION

Admiral **Gayler**. As to the purposes of verification.

First, as guidance in drafting treaties and agreements, many treaties and many agreements, whether explicit or implicit, suffer from the fact that they were not drafted carefully to facilitate verification. For example, a treaty limiting explosion to 150 kilotons is very much harder to verify precisely than one that says no explosions at all. That you can verify.

The second is insurance against a significant surprise or breakthrough. Most of these scenarios are very often overdrawn in my judgment but you want that insurance.

The third, obviously, is to build political support for arms control.

And the fourth is confidence building between the adversaries. Each of us must have increasing confidence that the other side continues to believe that arms control is in its best interests, that continues to act in accordance with that interest, and that there are no covert actions at variance with the agreed controls.

Thank you.

[The following information was received for the record:]

## VERIFICATION, COMPLIANCE, AND THE INTELLIGENCE PROCESS

### I. VERIFICATION EXAMINED

Nothing has impeded the negotiation of nuclear arms control agreements more than the vexed issues of verification. "What if the Soviets cheat?" marks at once a genuine concern on the American side and also a stick with which to beat any proposal for arms control. "Concealed espionage" and "affronts to our sovereignty" are the counter-slogans, genuine or otherwise, of the Soviets.

The issue is little understood. Most discussions fail to distinguish between three quite disparate ideas:

Juridical verification—detection of any departure, however insignificant, from the legal test of an agreement.

Political verification—sufficient to give politically adequate assurance, both in our system and the Soviet, that adversary actions having political impact can be adequately verified.

Military verification—detection of violations or other adversary actions that make a significant difference in the chance or outcome of nuclear war or the power positions of the adversaries.

Note that verification, strictly speaking, deals only with adherence to agreements. The term is often used, however, to cover any adversary action, whether covered by agreement or not.

Each of these ideas has importance of its own, but it is particularly necessary not to confuse the ideas as we examine the technical bases for national means of verification.

Nor should we confuse issues of verification—the finding of fact and the resolution of questions, with issues of compliance—the enforcement of obligations.

There seem to be at least four purposes of verification—all are important:

Guidance in drafting treaties and agreements. Many treaties and many agreements, explicit and implicit, suffer from the fact that they were not drafted carefully to facilities verification. For example, an agreement specifying an upper limit on the size of underground nuclear explosions is far harder to verify than a total ban.

Insurance against significant surprise, or "breakout." Most "breakout" scenarios are distinctly overdrawn: they are neither credible nor significant. But insurance that there will be no undetected changes seems politically necessary.

Building political support for arms control. Both sides must believe that the risks of an arms control agreement are smaller than the risks of not having it.

Confidence-building between the adversaries. Each must have increasing confidence that the other side continues to believe that arms control is in its best interest, that it continues to act in accordance with that interest, and that there are no covert actions at variance with agreed controls.

### II. COMPLIANCE AND STRATEGIES

The intelligence process, which is the basis for national means of verification, will invariably uncover various questionable activities by the adversary. Some findings are ambiguous as to fact but clearly relevant to a treaty or understanding. Some are the reverse: clear as to fact but uncertain in relevance or interpretation. Some are ambiguous both as to fact and interpretation. Others seems clear-cut, at least in the mind of one adversary. Some may have military signifiance; to date, most do not.

Each side must develop a strategy to deal with this mix. Among great powers there is no mechanism for enforcement by appeal to a court. There is little prospect for effective coercion by stick or carrot, or appeals to international opinion. Effective compliance can come only from the self-interest of each adversary in the continued life of the agreement. This in turn requires assessment of the risks and gains from violations, whether covert or open. Verification must insure that violations are not likely to remain covert.

### III. VERIFICATION AND THE INTELLIGENCE PROCESS

Verification of treaties and understandings is of course only one facet of the intelligence process, which operates continously in all sovereign states, and indeed many other entities. This process has five dominant characteristcis:

Intelligence is not positive or determinate. No one can say with total confidence that a given action will or will not be detected. There is some small chance that we have a "mole" in the Kremlin, and all Soviet actions are open to us. There is a very high probability that if the Soviets build a replica of the Pentagon on the banks of the Moscow River, we will detect it. All else lies between. But if advantage depends on remaining covert, the side that intends to cheat must be highly confident of remaining undetected. This is a very demanding requirement—far more than that of the adversary, who needs simply a good chance of detection to make the cheating unproductive.

Intelligence is interactive. Human intelligence brings counterintelligence. Signals intelligence evokes encryption, countermeasures and suppression of signals. Industrial intelligence brings controls. Political intelligence results in smokescreens and indirection. Challenge and response characterize the process.

Intelligence is highly synergistic. Different means of collection suggest to each other where to look. Analysis is essentially putting together parts of a puzzle to find the best fit. In no other field is it more true that the whole is far greater than the sum of the parts.

Much intelligence collection is vulnerable and necessarily secret, for the very good reason that if the means of collection are known to the adversary, they will be lost. The agent will be shot or the communications encrypted. This places a great burden on the public conduct of policy, for the full picture is not open to scrutiny. Conversely, policymakers have not always resisted the temptation to invoke secret information, unjustifiably, to support policy.

Intelligence is more than the amassing of information, or the direction of the interactive process of collection. In the end, it is expert opinion based on careful analysis. It can never be absolute, nor better than the expertise and probity of the analyst.

### IV. AGREEMENTS

Verification is again an aspect of the total intelligence process, which goes on whether or not treaties are in force. But arms control treaties and agreements may, and generally do, contain provisions to facilitate the collection of information and the analysis of intention, by mutual consultation. These cooperative measures are major confidence builders, both a cause and a result of the perception of common interest in arms control.

Too much, however, can be made of the necessity for cooperative measures, such as on-site inspection. The Soviets, with characteristics paranoia about espionage and touchiness about sovereignty, have low tolerance for intrusive inspection. But our own is not unlimited.

It is difficult to imagine Soviet technologists crawling around Minuteman silos, though what they might have to gain by eyeballing them remains exiguous. The purported need for on-site inspections has in the past been used somewhat disengeuously to torpedo arms control agreements otherwise in the clear interest of both parties. It is therefore particularly important to focus verification technology on improved means, such as improved seismic detection or high-resolution radar, that obviate requirements for intrusion.

### V. TECHNICAL CONTRIBUTION

For these reasons, while cooperative means are useful and desirable, confidence in compliance with arms control agreements must rest primarily on independent national intelligence. Capabilities that are totally under the control of the observing power and that involve the least intrusion on sovereignty are to be preferred. Here is where improvement in the technical means of collection can make real contributions.

For example, ongoing improvements in satellite photography, increasing coverage, improving timeliness, or enhancing detail are all useful. Virtual aperture radar promises quasi-photographic coverage at night and in bad weather. Enhanced sesimic signal detection and analysis may yield assurance that underground events of low yield can be reliably detected and differentiated from eathquakes. A major unsolved technical problem is the analysis of ballistic missile tests, absent useful telemetry. Observables in the field of signals intelligence are less precisely defined but no less important, and technical progress in this area is very important.

### VI. SENSITIVITY ANALYSIS

A major consideration in the design of national intelligence for verification is the need to bring convergence among legal verification, political verification, and military verification. Legal requirements of treaties should not be more restrictive and detailed than is required for security and to assure political acceptance. Political acceptance should be informed by realistic appraisal of the military and physical consequence of covert and undetected noncompliance. Here is a major and neglected need.

To a first approximation, the consequences of a general nuclear exchange between the great powers, at their present force levels, appear generally unaffected either by numbers, reliability, or delivery technolgy.

On the other hand, targeting policy, force application, fuzing policy, readiness states, force generation, circumstances of initiation, and tactics may make discernable differences in the outcome.

These general intuitions above need careful sensitivity analysis, to confirm and quantify the variables in the nuclear force equation that make a difference and those that do not.

Only in this way can treaty understand which elements are important.

For example, if numbers are now so far above the saturation level that major increments or decrements make little difference, then preoccupation with numerical balance (or, derivatively, stability or reliability) is misplaced. Verification requirements in turn are affected, as are also requirements for stockpile reliability testing.

Similarly, sensitivity analysis can show the extent, if any, to which an outcome would be affected by new weapons developments, and therefore guide verification requirements in that area.

### VII. VERIFICATION TECHNOLOGY

National technical means of verification are accepted without question as a legitimate and inherent component of arms agreements. They are not the only component, and may sometimes not be even the principal component of the capability of national intelligence to check adherence. But they are visiable, avowable and understandable, and therefore important in sustaining political confidence.

Adequate support and technical improvement are therefore essential. In the intelligence field, as in many others, you tend to get what you pay for. The technical improvements, attained and potential, that are described elsewhere herein are examples of development that will pay off many times in confidence that we can safety negotiate agreements to reduce the risk of nuclear war.

Mrs. **Byron**. Mr. Mavroules.

Mr. **Mavroules**. Thank you very much.

Let me thank both of you for testifying here this morning. We talked about reducing the risks of nuclear war, and really if you are going to totally reduce it you have to eliminate all nuclear weapons, let there be no question about that. If we have 10,000 nuclear warheads and the Soviet Union has 8,000, we reduce down to 5,000, they reduce down to 4,000, in my judgment that doesn't eliminate the risks of a nuclear confrontation.

All you are doing is talking about numbers.

I think we have a larger question here that has to do with verification. It takes me back a couple years ago to the time when Mrs. Byron and other Members went to Geneva. We talked with the Ambassador at that time negotiating the chemical and binary weapons. When he had an opportunity after his session to talk with us, he took us into a long, long history of the Soviet Union and he said to us, that the Soviet Union lost 20 million people during World War II, and never, never, never again, he said to us, will we allow that to happen to our people in the Soviet Union.

He did say that at that moment he had just finished a little letter to his granddaughter who at that time was 6 years old, and said, "I failed in my effort to bring about an agreement with the United States on chemical and binary weapons."

You see, the problem I think goes a lot deeper. It isn't a question of how many nuclear warheads we have, or how many does the Soviet Union have in their arsenal. In order to break through, in my judgment, without talking about capability, nuclear capability, or retaliation, or for that matter, deterrence, is, how can we break through so that perhaps we could have a better understanding of each one's culture, find out what they need for their security at a minimum, and find out what we need for our security at a minimum.

The thing that bothers me the very most is I am worried about other countries gaining this capability and other countries could, as many—maybe 5 to 10 other countries by the year 2000, 2010, could have the capability of nuclear weapons, and then we are going to be in trouble. We are going to have some serious problems at that point.

You know I have heard the argument for years, at least for 7 years that I have been here, that if we continue our buildup, economically the Soviet Union cannot keep pace. I don't believe that. I have heard that argument. I think it is a red herring, to be very honest with you.

I don't believe that no more than did I believe when I referred to the MX missile, which my colleagues are well aware, you need these to bring them back to the table. In my judgment, that is a lot of hogwash, but that is my personal opinion.

The point is that rather than talk about SDI and talk about more submarines and talk about more deterrence because they are going to do, they are not going to stand still, they are going to do something else, how in God's name can we break through the distrust and mistrust we have between both countries? And at what level, if you have an opinion on this, can we attack the problem in that area, rather than a weapon system? Would you like to comment on that?

Admiral GAYLER. I think I suggested several ways in which to do that. One has to do with our political language and the mutual vilification. I think that is dangerous.

The second has to do with more contact of every kind, including official contacts, facilitating them, trade, the practical contact of military staffs, much better than an obsolete teletype machine, and scientific contact of all kinds, by no means a one-way street.

You don't have to approve, and I do not approve, either Soviet actions internally or externally or their ambitions so far as they manifest themselves elsewhere, to understand—I will speak as an intelligence officer, if you will—to understand it is very important to understand them and not to create some image which doesn't correspond to reality.

All of these things I think are important, but perhaps the most important, in my judgment, is that we should abandon the negotiation hostility to everything Soviet and they should abandon negotiation hostility to everything American.

Mr. **MAVROULES**. I realize that. How do we do that?

Admiral **GAYLER**. I have made some suggestions. I think that a concrete effective arms reduction process would have major political consequences that would in and of itself improve our political relationship.

I also think that it would be quite important to get to a residual, fairly small, invulnerable deterrent rather than the situation we are now in.

Dr. **CARNESALE**. You raised several points. One is to the relationship between the numbers of weapons and the risk of a nuclear war. I agree with the view that arms control has focused too much on the numbers and types of weapons.

If you reduce the arsenal by half, that might make a political difference, but technically it wouldn't matter very much. Such action might reduce the risk of nuclear war by reducing its likelihood. Even if we can't see very much that we can do in the near term to reduce the consequences of nuclear war if it should occur, we can do a great deal to reduce the likelihood of such a war.

Given the sizes of the arsenals on both sides, I find it literally incomprehensible that the leader of either country could make a rational decision in which he concluded that his country would be better off with a nuclear war than without one. I would like to keep it that way.

One reason why it is that way is because there are so many nuclear weapons of so many kinds. The danger, I and my coauthors of "Hawks, Doves, and Owls" believe, is not of rational decisions, but rather of things getting out of control. World War I would be an analogy: Nobody wanted war on that scale.

There are things we can do to reduce the likelihood of inadvertent war. Some of these involve reducing misperception, some involve things like hot lines; some involve removing short-range weapons from areas near the inter-German border; some involve installing permissive action links on Soviet and American weapons.

There is a great deal we could do independently that doesn't rely on the Soviets at all. There are other things that would require cooperation.

So there is much to be done to reduce the risks of nuclear war, mostly by reducing its likelihood. Still, if it happens, it is going to be a disaster.

Mr. **MAVROULES**. Let me follow up on that, because you came in pretty good. My own feeling is that if we can eliminate part of this mistrust, then I think we can be a little more objective in all kinds of negotiations.

On the very same trip, we talked with the other Ambassador from the Soviet Union with reference to conventional systems, reduction of the numbers of people in Germany and that part of the world, they were willing to talk about those things, yet when we talked to the Soviet Ambassador, this kind of stunned me to an extent: Sure we can talk numbers at this point. We are even willing to talk reduction of troops and military people, but we do not want to talk about verification for 3 years.

This is where I think our country takes the proper position. If we are going to have an agreement with the Soviet Union, or for that matter, any country, we should be able to verify that agreement, at least to a great extent, so that one side does not make the other vulnerable.

They are unwilling to talk about verification for 3 years. The same gentleman on chemical warfare—unwilling to talk about verification for 3 years.

How can we eliminate the 3-year space there? How can we get the people to talk about verification with the agreement, something that we can do together? That is the real serious problem. I think that is going to be a problem.

I pray to God, along with all people, that the President is successful in Geneva, in the second and third talks, I hope they continue.

How can we eliminate that mistrust? I have asked that question many times—and I am not an expert; I think you people have perhaps been around in that area more than we in this Congress. Until we attack that problem, I don't see any success. That is my honest opinion.

Dr. **Carnesale**. You are more pessimistic than I am. I don't trust them. Historically nations tend to take advantage of the power they have. I see no reason to believe the Soviet Union would not do that.

I see no source of power that the Soviet Union has other than its military power. It is not like the United States.

The United States has economic influence, and many people want to imitate our society. We have all kinds of levers we can pull; they don't.

Our relationship is going to be competitive but that doesn't mean that it has to be dangerous. It doesn't mean that they want nuclear war or that we want nuclear war.

As to verification, if they say they don't want to talk about verification for 3 years, I take that as a pretty good signal that they don't want an agreement at this stage.

Also on verification, let me make another analogy to illustrate that we demand more from verification than just assurance that our security be protected.

I ask you to imagine that you are the owner of a small firm. You have an accountant working for you. He is terrific. He earns $30,000 a year. Any other accountant as good as he is would cost $50,000. This guy is really great.

You just found out he is stealing $5,000 a year from you—$5,000 a year. But even with this, he is only costing you $35,000 a year. To go out and hire somebody as good as he is would cost you $50,000; that is, $15,000 more.

What do you do? You fire him! I don't know any American who would keep this guy even though he is a crook. I wouldn't want a crook working for me. I don't want to deal with a crook.

Now, I can make the problem harder. Suppose you find he is stealing 5 bucks a year. For 5 bucks, you'd probably keep him. If this guy occasionally beats on the Coke machine to get some free

Cokes, that doesn't mean we have to fire him at a cost of nearly $20,000 a year. But on the other hand, if he really is a crook, we don't want to do business with him.

The Soviets must realize that if the American people believe that they are cheating, there is a problem, whether or not they are cheating enough to endanger our security. We don't want to deal with a crook.

And so they must learn not to get into positions where we believe that they are cheating. Krasnoyarsk is more important than anything else on the White House list of Soviet violations. In SALT I, we spent a lot of time with them talking about phased array radars. It was a matter of grave concern to us.

I am sure that Paul Nitze feels betrayed by the Soviet action at Krasnoyarsk. They have to realize this. Either they are going to roll this one back or come to some sort of accommodation with us, or I don't think we are going anyplace with arms control, and I don't think we should.

Mrs. HOLT. Thank you very much, both of you gentlemen.

I am sorry I came in late and missed part of it, but I would like to say that I feel, as Mr. Mavroules has said, that we are all prayerful we are going to be able to accomplish something. We do have to keep talking. I think it is very, very important that we continue our negotiations, that we try to understand each other better, and move closer. But it seems to me that really, the bottom line is this very thing that you have been talking about here, this lack of trust, and there is no reason to trust now.

The admiral says that if we stop the rhetoric—we know we can stop the rhetoric, we did it during the Nixon-Carter years, we tried to work out détente. Mr. Carter was very, very pleasant, said a lot of nice things. He was shocked when they went into Afghanistan. He was as kind and sweet as anybody could be. During all of those years we built no missiles. I heard Harold Brown say that we should have built a missile in the seventies. We said we were going to build it next year, we kept putting it off and didn't do it. We scrapped the bombers, we didn't build our bombers.

What did they do during that period? They had the biggest buildup that they have ever had. They continue to build up.

We went to Somalia where they built a naval station. We talked to President Siad Barre. He said that they had discussed their plans with him, they are going to come right down to the warm water ports across Africa and into our hemisphere.

We talked to Marshal Ogarkov and he said we will never be No. 2 again, we are going to do it.

I said why? We are not going to attack you, and he said because we want to further our form of government around the world.

How do they do that? Just as you said, through power. That is the only thing they have, that military power and they are going to use it.

And how do they control their people to keep them in that kind of situation? Through oppression, through keeping them ill-informed about freedom. If the people of the Soviet Union knew anything about freedom they wouldn't be able to control them. I keep hoping that maybe the answer is that communications become better, that some day we will be able to reach them, but I don't see any way in the world we can trust people.

President Kennedy said after the moratorium on testing, that that was the biggest mistake we ever made. If we were fools enough to agree to something like that again, we deserved whatever we got out of it. So verification, no matter to what extent it has to be the bottom line, you can't verify if you can't have on-site inspection, if you can't have some kind of mutual trust.

So my question to you, Admiral, is how does he think that all of these things that we have done, tried before, and it didn't work, how does he think it is going to work now?

### MILITARY STRENGTH NECESSARY

Admiral Gayler. Mrs. Holt, in this tough and dangerous world, I am a very strong believer in the necessity for the military strength of the United States. I think I know what it consists of. It consists of the ability to keep the seas and the air above them open, which link together an ocean alliance that we call the West.

It consists of the capability to hold and defend ground in Germany and Europe and NATO and Korea, without resorting to the use of nuclear weapons.

It consists of being able to project and sustain power at great distances.

Now, these are things none of which nuclear weapons helps you with.

Mrs. Holt. Let me interrupt you right at that point and say during the period that we had nuclear superiority, wasn't it a deterrent? We didn't see the mischief we have seen since the Soviets have gained nuclear parity, or whatever it is they have today. Since that has occurred, they have become very aggressive around the world. Isn't that true?

Admiral Gayler. The period that we had nuclear superiority was so short. It was about 4 years actually between our bomb and their bomb. Much less than that between our ICBM——

Mrs. Holt. Are you saying that nuclear superiority has nothing to do with it?

Admiral Gayler. I think that, Mrs. Holt, I must say what I think. What I think is that nuclear weapons have no military utility.

Mrs. Holt. Wait a minute, I want to get that in the record. You are saying that nuclear weapons are not a deterrent?

Admiral Gayler. No, ma'am, I am saying nuclear weapons have no military utility.

Mrs. Holt. Deterrence to me is the main thing. I don't think anybody should fight any kind of war. If we fail in deterrence, I am ready to surrender. I give up, because I think we have failed. Nobody wins a war. So you don't think it is a deterrent?

Admiral Gayler. I am not prepared to surrender under those circumstances or any other. Let me say quite precisely, I do not believe that nuclear weapons have any sensible military use. I do believe that they deter nuclear war. Those are two quite different and quite consistent statements. They will deter nuclear war, in my judgment, when they are invulnerable and sufficient to utterly destroy the adversary. That is the situation we should be in with respect to nuclear weapons. The situation we should be in with respect to conventional weapons, we should be able to keep the seas open, to be able to project and sustain power, to be able to hold ground. That makes military sense to me.

Mrs. HOLT. Well, I hope you are right. I really would like to believe in it but I don't know how we are going to put that nuclear genie back in the bottle. If we don't, it seems to me that there is a great danger there and I am convinced that that is what has kept the peace in Europe for the years that we have had peace in a situation there that could have been very, very dangerous.

Mr. MAVROULES. Would you yield? I would like to follow up on what you are saying here.

Admiral, I get the impression from you, because you know we get other testimony during the course of the year from generals and admirals, as you well know, did I hear you correctly stating that we have enough deterrence or deterrent in our conventional forces today? Do we have that capability against the vast number put up by the Warsaw Pact nations versus the NATO nations?

Admiral GAYLER. No; I didn't say that.

Mr. MAVROULES. I thought you did.

Admiral GAYLER. I said these are to me the military capabilities that we need. I think that we are in fairly good shape even against the growing Soviet Navy at sea, although we better not——

Mr. MAVROULES. You would agree that the modernization program put forth by the last year of Mr. Carter and 5 years of Mr. Reagan should continue in the modernization of conventional forces?

Admiral GAYLER. I think if we spent the effort, and particularly the technical effort, that is now contemplated for SDI—which in my judgment will get us nothing useful—if we spent that on such tasks as obsoleting the Soviet tank armies—which in my judgment is technically possible although expensive—given the kind of technical work that we are capable of, and improving our position vis-a-vis submarines and a couple of other things like that, that we could breathe a lot easier and we will not have to be in this threatening position with respect to nuclear weapons.

Mr. MAVROULES. I appreciate that. Thank you.

Mrs. BYRON. I appreciate that. Thank you.

Mr. SPRATT. Thank you.

We have had testimony from witnesses from Livermore Labs and from Sandia and Los Alamos about the comprehensive test ban treaty and particularly about a bill which encouraged the President to proceed with negotiations of such a test ban. They have opposed a test ban on several grounds. One is verification. We touched on that. But they also said that this would have an impact on the reliability of our stockpile—which you touched on—that it would as well leave us with incomplete understanding of the weapons we have in our arsenals and would impede improvements, many of which could be stabilizing. For example, Midgetman.

Now, they acknowledge that the warhead for Midgetman is basically tested out but if we decided to go a different technology, we wouldn't have choices available to us and you can make the argument D-5 is a more stable system than MX, and we haven't completely tested five warheads.

Would you respond to these arguments and at the same time state the gains that you see we would obtain from a comprehensive test ban if one were implemented, and if it were adequately verifiable?

### TEST BAN TREATY

Dr. **Carnesale**. Well, let me try and address that first. The way you pose your question is just right. The arguments made by previous witnesses have validity. They pointed out the costs of a test ban. A test ban constrains your ability to test. Therefore, you lose some reliability, and you lose confidence in any new kinds of weapons that you develop but are unable to test. That is right. Anybody who denies this hasn't got his head on straight. Otherwise, why have we been testing all these years?

But if I look only at the costs of an arms control agreement, without bothering to look at the benefits, I don't need a computer or thousands of dollars or lots of analyses to tell me that it is not in my interest. So the question is, what are the benefits? Do the benefits outweigh the costs?

One benefit is that a test ban keeps the Soviets from having high confidence in their weapons, and inhibits their development of new weapons. Does it do so perfectly? No. But it would have a significant impact.

Who is it that needs the higher confidence in their weapons, the country that is going to strike first, or the country that is going to retaliate?

Think of what kind of an operation a first strike is. You have to come close to disarming the adversary, because what is at risk if you fail is the survival of your nation. This is a very difficult thing to do, even with weapons you have high confidence. If you must rely on weapons in which you have only moderate or low confidence, forget it. You wouldn't even think about it.

What about the retaliator? I already suffered the enormous damage from the first strike. What am I worried about? Will I be able to destroy the other society to get even?

Suppose I can't. What is at risk? The other guy's country, not mine.

It is a very different situation for the first striker than for the second striker. The first striker needs much higher confidence. Even taking into account the possibility that the Soviets might be able to test some very low yield devices without our knowledge, they would be a long way from having the kind of confidence they want to have in planning a first strike. I do not pretend that there aren't costs to a comprehensive test ban; there are. But I believe they are outweighed by the benefits.

Mr. **Spratt**. Admiral Gayler.

Admiral **Gayler**. I would like to comment that in my judgment a disarming first strike by either country is not possible for the good reason that the retaliatory capability of each country is largely lodged in submarines, which cannot reasonably be attacked by a first strike no matter how good your antisubmarine capabilities are, and they are not good on either side, compared to the submarine. You are not going to kill submarines in the first 20 minutes or the first hour of an engagement.

There are places for Soviet submarines to hide under the Arctic ice, where we can't get at them, and there are many, many places in the ocean of the world where the Soviets don't even have an antisubmarine capability and have no prospect of getting any.

So to look at the problems in terms of are you able to take out the missile fields, I think is looking at only part of the problem. It is to me an unreal suggestion that either side can attain a disarming first strike no matter how accurate the weapons are or how powerful.

Mr. Spratt. Dr. Carnesale, you mentioned systems the Soviets are developing in the area of BMD or ABM, where they have a possible lead over us and where there is the potential for breakout. You have suggested as a cautionary measure, at least, a measure of prudence on our part. We should be devoting some of the SDI money we are proposing to those areas which are risky areas we ought to be concerned about.

Could you be more specific about the systems you perceive that the Soviets have a lead in?

### AREAS WHERE THE SOVIETS HAVE THE LEAD

Dr. Carnesale. Yes; I should make clear that I am not talking about a technological lead. What I am talking about, for example , is the ABM-X-3 sort of system, which employs rather conventional technology. This system includes small radars that are not quite mobile, but look like they might be relatively rapidly deployable. We have no comparable system; that is, no such U.S. system has been brought to full field test. You may remember the Low Altitude Defense System, which we essentially stopped before it was brought to field test.

We have no system based on conventional technologies that is getting serious attention. So we are lacking the two fundamental things you would think of as immediate responses to a Soviet breakout from the ABM Treaty. One is penetration aids. We would off-load some reentry vehicles and replace them with decoys and other things. We do not have those stockpiled. We know how to beat those Soviet systems. This is not a question of technology. The question is whether we have the hardware, and the answer is no. Nor have we had an active test program in recent years to make better penetration aids. I would revitalize that program, and even go to some production.

The second response, like the first, is intended to deter the Soviets from abrogating the ABM Treaty. If they know we can penetrate their ABM system, they are not likely to tear up the treaty to deploy it. Similarly, if they know that we have an ABM system ready for deployment, they're less likely to abrogate. We are not far behind, we just don't bring systems to full field test.

The politics in our country makes this difficult. The budget question becomes: Why do you want to test something that you cannot deploy under the ABM Treaty? The answer to that is I want to test it to deter the Soviets from abrogating the treaty and as a hedge in case they do. I prefer a world in which neither of us has extensive ABM systems, but my least favorite world is one in which they have them and we don't.

Admiral **Gayler**. Madam Chairman, I would like to make a comment off the record. May I do that?

Mrs. **Byron**. Yes.

[Discussion off the record.]

Admiral **Gayler**. We have no problem without penetration aids.

Dr. **Carnesale**. They also have no meaningful ballistic missile defense system. I was talking about the situation if they were to deploy one. We know how to penetrate, but we don't have the penetration aids.

Mr. **Spratt**. You are saying they don't have a ballistic missile defense system?

Dr. **Carnesale**. Right now we don't need penetration aids because their ballistic missile defense system is so limited that we can simply swamp it. Suppose they had the 100 interceptors they are allowed in Moscow, and that they worked perfectly. If we unloaded one Poseidon submarine on Moscow, that would be 160 warheads. So 60 warheads, each with a yield larger than Hiroshima and Nagasaki put together, would explode on Moscow.

What I was talking about is a hedge against the Soviets breaking out of the treaty and deploying something like the ABM-X-3 widely over a period of several years. Even though we know how to penetrate such a system, we don't have the penetration aids in hand. I don't want to rely on just swamping their defense.

Admiral **Gayler**. We haven't got them stockpiled and they don't have the defensive system stockpiled either.

Dr. **Carnesale**. They have a production line for the defensive system. We don't have a production line for penetration aids. That would be something I would do. It is an easy thing to do.

Mr. **Spratt**. What you are saying also is if we start building these penetration aids as a signal to the Soviets, their further explanation——

Dr. **Carnesale**. It deters them. It eliminates or reduces any incentive they might have to try to break out of the ABM Treaty.

Mr. **Spratt**. Thank you.

Mrs. **Byron**. But isn't it my understanding then that the Soviets are building their own ballistic missile system currently?

Dr. **Carnesale**. There is the system at Moscow that I was describing. It is of the sort that we are each allowed under the ABM Treaty as modified by protocol—one antiballistic missile site either at the national capital or to defend an ICBM field. We built ours at Grand Forks.

Mrs. **Byron**. We don't think much of our capital?

Dr. **Carnesale**. Well, I think there is an interesting difference here. If you ask most Russians—I am talking about Soviet Russians—what single place do you want to defend, they would probably say Moscow. Moscow is Russia.

If you ask an American to name one place to be defended, he would probably say that he doesn't care where, so long as it's not where he lives and not Washington.

Mrs. **Byron**. I have one other area that I think I really would like to touch on. This is really an opinion question, and what do you really think has brought the Soviets back to the negotiating table? From your experience as a negotiator, do you see some concessions, potential concessions, that they feel might be made, or what do you think was the moving force?

Mr. **Carnesale**. Well, I think there are a couple of factors that brought them back to the table. Probably most important was the failure of their strategy in Europe with regard to the intermediate range nuclear forces. They tried hard to stop the deployment.

Mrs. **Byron**. They threatened to walk out except they didn't really walk out until a week before.

Mr. **Carnesale**. They tried to use that deployment in many ways. They were not successful. I think that was a particularly important factor.

A second important element is the strategic defense initiative. Let me explain why I believe that.

First, if I were a Russian and I was going to get in a competition with the United States, I wouldn't pick technology as the area in which to compete. But I think the dominant one is rubles. If the United States goes forward with the SDI, even if it is far from perfect it will cost a lot of Russian rubles to deploy the countermeasures to compensate for it. The fact that it cost the United States a lot as well doesn't help. It would still cost the Russians a lot. I think they are trying to do something about their economy, and about meeting their consumer needs, and they just don't want to get into an all-out competition with us in another area. Even if it wouldn't put them at a military disadvantage, it would cost them a fortune.

Mrs. **Byron**. Admiral Gayler.

Admiral **Gayler**. Yes, just a comment. In my judgment, it would not cost the Soviets a lot of rubles to overcome the SDI.

Mr. **Mavroules**. May I respond to that?

Mrs. **Byron**. Yes.

Mr. **Mavroules**. I think I agree with almost everything you say this morning, Doctor. I disagree with you on the last statement about the rubles. That is the same argument I have been listening to for the last 7 years—eventually economics will catch up with the Soviet Union if we continue to put pressure on them. I have been listening to that argument for 7 years. In the meantime they continue to build and build and build, and I think they are willing to spend all the rubles in the world to see if they can overcome any part of the strategic defense initiative. I think they are willing to sacrifice to overcome any part of the strategic defense initiative if they can, even if they have to do it in sheer numbers.

If they have 10,000 warheads today, in my judgment, I think they would build 40,000 warheads to overcome the SDI Program, if they thought they could do it. I think we are wrong if we continue to use that argument. Maybe you might want to clarify that somewhat?

Dr. **Carnesale**. I agree with everything you said. The fact that they would be willing to spend a lot of rubles doesn't mean they desire to spend them. I don't think any of you like a $200-billion-a-year deficit, yet you are willing to create it.

Mrs. **Byron**. When you look at the options?

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Dr. Carnesale. You would much prefer getting a deficit control agreement that would cost you virtually nothing.

Mrs. Byron. We are going to do that next week.

Dr. Carnesale. I am quite serious. If they could constrain the threat so they didn't have to counter it and therefore, would not have to spend the rubles, that would be their preference. That is not to say, nor does it imply, that if there were no agreement, they would roll over. They will do that no more than we would roll over.

Mr. Mavroules. Thank you.

Mrs. Byron. We wouldn't roll.

Let me ask you, the two other areas we touched on, and in our openness in our society, we happen to feel very strongly on that, so we operate under those criteria. We have touched verification and Admiral Gayler thinks that we have adequate verification, they have adequate 100 percent verification with us currently because of our proposals. With 100 percent verification of the Soviets, which I think is going to be improbable, and I think we would be wrong to insist on 100 percent with this concept, there would be no way we could get that.

For the verification issue should we not insist on some concessions from the Soviets if we go down from 100 percent verification, some fairly strong concessions?

Dr. Carnesale. Well, we have gotten some such concessions in the past. It is not as if nothing has been done. Consider the recognition of national technical means, the agreements on not interfering with them and on no deliberate concealment, and the notion of functionally related observable differences. None of those things were Soviet ideas, and none were Soviet preferences.

Also, you don't get concessions for nothing. You pay prices for concessions. The more verifiable an agreement, the better, other things being equal. But if we must pay a price for improved verification, I want to know what the price is, especially if verification already is sufficient to safeguard our security.

I think they are willing to do more now, but we should be careful. For example, we might have to pay an enormous price for on-site inspection, which in most cases borders on the useless.

Mrs. Byron. Haven't we already paid the price because we cannot verify them 100 percent and they can verify us 100 percent?

Dr. Carnesale. There is no concession that will change that, other than our willingness to adopt their form of government or their willingness to adopt ours.

Mrs. Byron. So our price has already been paid, if you mean that the difference in our society is that we sacrifice something in verifiability in giving them more information than we get from them. We sacrifice that in order to gain the benefits of our open society and our way of life?

Dr. Carnesale. The Russians don't impose that on us. We choose to have an open society because we have values that go beyond keeping secrets from them. That is our choice. It is an assymetry that we are going to have to live with, and there are some arms control agreements that would not be in our interest for that reason. You have to look at each one on a case-by-case basis. But, as you point out, verification is not their problem, it is our problem.

Mrs. **Byron**. By that theory we should eliminate that past problem because it is our choice to give them verification?

Dr. **Carnesale**. It is our choice to give them an advantage in verification. That is correct. How much are they willing to give us? That has to be at least enough to make us better off with the agreement than without it. If they are not willing to give us that much, we shouldn't sign.

Mrs. **Byron**. One other area that has concerned me, is some legislation we passed yesterday. The House, in the Defense Appropriations bill denied the funding for binary weapons. Will that, in your estimation, increase or decrease a chance for a comprehensive ban on chemical weapons? That has to play into that scenario I think.

Dr. **Carnesale**. I am not an expert on chemical weapons. Let me start by saying that.

Mrs. **Byron**. There is a chapter in our book.

Dr. **Carnesale**. As far as negotiations in general, I believe that there is a great deal to the notion of bargaining chips and bargaining leverage. It gets abused so much that it has lost much of the credibility it deserves.

The reason that the Soviets are interested in arms control agreements is to constrain American arms. The reason we are interested in arms control agreements is to constrain Soviet arms. It is not to constrain ourselves. So if the Soviets believe that the United States is not likely to proceed with chemical weapons and would destroy its stockpiles, it would be foolish for them to enter into an agreement that constrains chemical weapons.

The question, to which I don't have a clear answer, is whether these binaries represent the straw that gets you under or over the hurdle.

Mrs. **Byron**. Under or over the camel's back?

Dr. **Carnesale**. Whatever the right metaphor is. So long as we have the stockpiles we have, even though they are not as modern as we would like, I suspect the Soviets will be interested in constraining chemicals. They would be more interested if we had a more active program.

Mrs. **Byron**. Mr. Stratton, do you have any questions?

Mr. **Stratton**. I don't have any questions, Madam Chairman, but I did notice in the paper this morning that the United States side is now going to propose an additional plan that would match the Soviet Union in the 50-percent cut and I would wonder whether we might be able to get Mr. Adelman or someone to fill us in on that particular proposal if it is not above our clearance level?

Mrs. **Byron**. We will try to get that information.

Mr. **Stratton**. Thank you.

Mrs. **Byron**. Mr. Klein, do you have questions, or Dr. Mansfield?

Dr. **Mansfield**. A few. A remark on the last response—the reason that the United States should want arms control agreements is to constrain the Soviets. However, I would remark that there are many people on the Hill that say that spending money on arms in the United States is a bad thing. One way to avoid that bad thing is to constrain ourselves with an arms control agreement.

Mr. **Carnesale.** You are right, there are people who feel that way. I don't happen to be one of them. Theirs is an erroneous judgment with which I disagree.

Dr. **Mansfield.** Admiral Gayler, you mentioned that nuclear weapons had in your view no sensible military use. The argument you eave is that we tend to have fewer and larger and more valuable targets, that we are more at Irisk id things go nuclear than the other side is, and for that 3reason we should see it in our best interest not to go nuclear.

In Europe, deployment to Europe assumes that the Soviets would immediately want to retaliate with nuclear weapons if we used nuclear weapons at all, and you gave the impression the reason for doing so was that they do this in a rage of retaliation because we had crossed a mystic boundary of some sort.

I would like to question that and ask your views on the following:

I am familiar with how nuclear weapons are used in Europe, or proposed for use in Europe. In most or all cases, scenarios for the first use of nuclear by NATO are extremely constrained, they are used against such things as massed military formations, against airfields, against nuclear storage sites, and that sort of thing. In particular they are used in ways that almost absolutely minimize collateral damage to civilians.

So the Soviets would have to reason the following way in order to say that the only recourse is to use nuclear weapons. They would have to reason that the United States has used nuclear weapons against these things which they could have destroyed with conventional weapons perhaps. They haven't killed any more civilians, maybe less than they would have by using conventional weapons. Nevertheless, because they have used nuclear weapons, I have to respond with the massive use of nuclear weapons. I think that is a logical thing for the Soviets to do and I ask your comments on that argument.

### MILITARY VALUE OF NUCLEAR WEAPONS

Admiral **Gayler.** Well, I think we are concerned over a different fact here. The place where these weapons purportedly will be used in the event of a Soviet incursion will be principally in West Germany, in areas which are comparable to say the Washington-New York axis. The notion that the use of nuclear weapons can be discriminate in the sense that you will be able to kill military forces and not kill civilians, I simply don't believe for a minute.

I have seen nuclear weapons of fairly small yield detonated in the second series of the South Pacific tests. I think one of the gravest difficulties that we have in addressing this issue is that people really don't understand the nature of them. I have no confidence at all in discriminate use in a crowded population. What I was talking about was not Russians killing our allies but us killing our allies, as the first consequence of an attempted nuclear defense.

Dr. **Mansfield.** The targets you mentioned, massed armored, airfields, and nuclear storage, two of them are always in the enemy territory, and one of them, we hope, usually is. I don't see why we would be killing our allies by at least attempting to be discriminate.

Admiral **Gayler**. Are you prepared to use these weapons in, for example, Poland, and, for example, East Germany? Are you prepared to use them in West Germany, after the Soviet forces have advanced in these scenarios? Are you suggesting that there is no way to make a tank attack except by massing the tanks first? None of these assumptions in my judgment are militarily reasonable.

Dr. **Mansfield**. Let me ask the first question. I am certainly prepared, if we are prepared to use nuclear weapons at all, to use them where it hurts. That turns out to be Poland as much as anything else. I would like to leave for later a discussion of using them in West Germany or countries further to the west if the Soviets have penetrated that far. That is probably a different story. I was talking about first use in order to blunt the initial stages of the Soviet attack.

On the question of whether the nuclear weapons rather than something else might be effective in destroying targets that would stop the Soviet attack, for instance against armor that may not have to mass, the whole reason they don't mass is because nuclear weapons are there. Everybody knows [the Soviets] know best, that massed armor is always better. The only reason that they have not historically since the Second World War would be the revolution in military affairs; that is, because of the threat of nuclear weapons. I don't think they will stick with that strategy very long if they don't have to worry about it.

Admiral **Gayler**. Do you want to continue?

Mrs. **Byron**. Yes, go ahead.

Admiral **Gayler**. I think we should get out of this controversy into a problem solving area. The problem solving area in my judgment is a use of our superior technology to be able to repel Soviet tanks without the use of nuclear weapons. It is my judgment that if we use our technology, particularly in information handling, at the cutting edge of the technology, for such things as identifying and characterizing everything on the battlefield, which I think we can do for such things as hitting weapons, which I think we can make much more effective than we have as yet—we have just begun on that, for such things as robotics—I think it is possible that the present stage of our technology to, for example, design a robot tank, which would have an exchange rate of perhaps 5 or 10 to 1 against a manned tank, and a commander would be able to use in combat situations where he wouldn't risk his soldiers. Those are the sorts of things which with a fraction of SDI's money we can do and will not only improve our defensive position in NATO, but also remove another incentive to ratchet up the nuclear arms race.

Dr. **Mansfield**. One final question. On the question of your action No. 8 to dilute your weapon grade material by diluting it down to the 3-percent level for powerplants, or whatever, isn't it true that fuel for nuclear submarines in all of the designs is weapon grade material and you have to produce that? How do you prevent diversion of materials that is supposedly for reactor fuel from submarine reactor fuel?

Admiral **Gayler**. That is an issue I didn't cover in my statement, but I am prepared to cover it now. What you do is a bookkeeping problem. Without going into it too much, you could have quite a good estimate of what the submarine's days at sea are and from that you could make some pretty fair statements of the burning up rate of nuclear material and therefore replacement rate required. You would provide for that in a clause of your agreement.

Dr. **Mansfield.** It requires reliance on national technical means and technical intelligence of that data?

Admiral **Gayler.** Yes, sir; it is not a very difficult task.

Mrs. **Byron.** I want to thank both of you for coming this morning. I appreciate you taking time out to give us your views on a subject that is extremely complicated and one that is very difficult. I think we are all still in the learning process.

The panel stands adjourned.

[Whereupon, at 10:30 a.m., the panel was adjourned, subject to the call of the Chair.]

# ARMS CONTROL OVERSIGHT

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HOUSE OF REPRESENTATIVES, COMMITTEE ON ARMED SERVICES, SPECIAL PANEL ON ARMS CONTROL AND DISARMAMENT OF THE PROCUREMENT AND MILITARY NUCLEAR SYSTEMS SUBCOMMITTEE,

*Washington, DC., Wednesday, November 20, 1985.*

The panel met, pursuant to call, at 10 a.m., in room 2118, Rayburn House Office Building, the Honorable Beverly Byron (chairman of the special panel) presiding.

## STATEMENT OF HON. BEVERLY B. BYRON, A REPRESENTATIVE FROM MARYLAND, CHAIRMAN, SPECIAL PANEL ON ARMS CONTROL AND DISARMAMENT OF THE PROCUREMENT AND MILITARY NUCLEAR SYSTEMS SUBCOMMITTEE

Mrs. BYRON. This morning we will continue the panel's arms control oversight hearings.

By this time, I believe that the panel members fully realize that arms control today is a most complex and fluid subject. Arms control presents political, international, technical, and sometimes factual concerns. A review of the prepared statements that have been submitted for today's hearing does not indicate to me that the arms control debate is becoming more understandable or less complex.

This morning, I want to welcome our witnesses, the Honorable William E. Colby, former Director of the Central Intelligence Agency (1973–1976) during the administrations of Presidents Nixon and Ford. Our second witness will be Dr. Lynn R. Sykes, professor of Geological Sciences at Columbia University.

This afternoon, we will hear from Dr. Kosta Tsipis, director of the program in science and technology for international security at Massachusetts Institute of Technology.

Mr. Colby has submitted a prepared statement that restates several of the problems that have been before us. I look forward to hearing his recommendations as to how these problems should be solved.

Dr. Sykes is a geologist and has submitted a detailed statement on the verification of the unratified Threshold Test Ban Treaty and the Comprehensive Test Ban Treaty that has yet to be negotiated. I should note at this point, that the conclusions reached by Dr. Sykes in his paper vary considerably from the conclusions reached by previous witnesses before this panel.

For example, he concludes that the Soviet Union has definitely not violated the Threshold Test Ban Treaty or provisions of the Limited Test Ban Treaty. Because of the technical nature of this subject, and its importance to the panel's deliberations, the Chair believes that staff should request that additional information be submitted on this subject by previous witnesses. Without objection, I will direct the staff to have this done. [See p. 390.]

Before we proceed with the first witness, I will yield to Mr. Courter for such remarks as he would care to make.

## STATEMENT OF HON. JIM COURTER, A REPRESENTATIVE FROM NEW JERSEY

Mr. **Courter**. Thank you.

I was asked by the ranking minority member, Marjorie Holt, to read her statement into the record at this time.

Madam Chairman, I join you in welcoming the witnesses today and I certainly agree that there is nothing about the current arms control situation that is amenable to simple, quick, and easy solutions. Our President is in Geneva today attempting to address some of the tough solutions and, I must say, that he is at least close to the root of the problem.

After reading the prepared statements of Mr. Colby and Dr. Tsipis, it occurred to me that the solutions to a great many of our problems are under negotiation in Geneva and that all of the offers that the Soviets have made at the bargaining table, as opposed to those made only in the press, have been taken up and seriously considered.

Madam Chairman, we cannot have arms control by unilateral actions on the part of the United States. Neither can we have verification of arms control by invocation or by methods based only on scientific and political theory. It is also a fact that we cannot have lasting arms control where one side feels free to do as it pleases while the other side complies with the terms of solemn agreements. I would appreciate it if the witnesses today would address those concerns.

Thank you, Madam Chairman.

Mrs. **Byron**. Do you want to proceed?

## STATEMENT OF HON. WILLIAM E. COLBY, FORMER DIRECTOR OF CENTRAL INTELLIGENCE

Mr. **Colby**. Madam Chairman, thank you for this opportunity to present my views on arms control and its implications for our defense and national security. I will offer in my opening statement only a short summary of my views and will try to be responsive to any questions or on any subjects you might raise.

My position is very simple. The nuclear arms race itself is increasingly dangerous to the security and safety of our Nation. The new weapons being developed pose new and more volatile threats of devastation while the resources they command divert our attention and efforts from other matters which can adversely affect our safety and well being, from the massive budget, with its implications for our economy and trade, to the Latin debt with its potential for demogogy and turmoil immediately south of us.

The best way to stop the arms race is simply to stop it. It is of course true that the existing levels of these dread weapons can destroy all of us many times over, but a freeze in the race would give at least the opportunity to undertake the difficult negotiations which could lead to their reduction. A ban on further testing would also arrest the process of developing new forms of these weapons and release that pressure from negotiations for reduction of the present levels.

### ARMS CONTROL NEGOTIATION DIFFICULTIES

Arms control negotiations suffer three burdens. It is difficult to design steps on the two sides which are equivalent reductions in themselves or which produce equivalent balances of remaining weapons, in view of the different ways in which the two sides have structured their forces. The ideological and national differences of the two sides produce statements and actions in the negotiating and other forums which raise questions whether agreements can or should be reached between them, and the United States is quite properly insistent that any agreements with the secretive Soviet Union must be fully verifiable.

Difficult as these may be, they can be overcome with will and intelligence. The Soviets have made very substantial offers in recent months indicating a desire for a mutual ending of the arms race, which is of course very much in their interests, as it is in ours. The small print in these offers is frequently loaded or unbalanced, but these details could be negotiated into acceptable balance if the offers were prosecuted seriously rather than rejected immediately.

There is little hope of resolving the fundamental differences between two societies, but a formula of equal restraints and equivalent reductions would assist in the process of adjusting to the other's coexistence on the Earth, and mutually limiting both countries' ability to destroy it and itself.

And these agreements can be made verifiable. The sweep of our intelligence capabilities today will monitor Soviet military activity whether there is an agreement between us or not, because we must do so. And we do a very good job, as many members know from their classified briefings. We have not experienced a strategic surprise from Soviet weaponry since Sputnik in 1957, but rather benefit from literally years of warning about some potentially dangerous developments such as the Krasnoyarsk radar.

The difference with an agreement is that we can communicate about the new development and in many cases obtain a change in Soviet behavior or clarification that a suspected activity is in fact not a violation. And an agreement offers the possibility of cooperative accommodations by the Soviets such as exchange of data, black boxes or other technological sensors and even inspection visits.

The main requirement is that we keep in mind that verification is not an element of a legal process, but that its object is to protect our country against strategic surprise. It is quite clear that our intelligence capabilities will point out any significant threat, whatever the chance that some marginal variation may not be immediately identified.

The Soviet Union will never be easy to negotiate with, Madam Chairman, but patience and resolve to end the arms race and reduce the present nuclear threat can be accomplished. This will not end the Soviet-American contest and tensions, but it could limit them to arenas less devastating to us all.

Thank you.

Mrs. Byron. Let me pursue a couple of issues addressed in your statement. One, you talked about patience, on your last page, to negotiate. I think the resolve is there for patience. This panel has had an opportunity on several occasions to meet with not only our negotiators that are in this series but the negotiators that were in the last two series of talks. I think the one thing that came through loud and clear to almost all of us was the enormous amount of patience that our negotiators are required to have and do have.

We had the three ambassadors before us last week. We met with them in Geneva just before the Russians presented their new proposals at the end of September, the first of October timeframe. I think this country has shown a very strong bipartisan commitment, within the Congress, within the administration, and among our negotiators to really move forward and leave no stone unturned in resolving this issue.

You said that on page 3, if offers were rejected immediately, we would make no progress. Do you have a specific set of proposals that were rejected immediately or what was the——

Mr. Colby. Certainly the idea of an interim test ban was rejected immediately by our Government.

Mrs. Byron. Was that presented on the table or was that in the news media?

Mr. Colby. Presented in a statement, but it was presented by the leader of the Soviet Union. I think we can pick it up rather than just say oh, no. Instead of rejecting it, say all right, let's go into this. Let's figure out how to do it, let's get the data.

We have stopped negotiations on a comprehensive test ban, this administration has. We have not gone ahead to ratify the limited Threshold Test Ban Treaty. I do not agree with your statement that we have worked every possible way of achieving agreement with the Soviets in these situations. Certainly they have made the public scene, no doubt about it. So have we. I think that that is what we have to get past. We have to take those kinds of offers and say all right, let's get serious about them.

Mrs. Byron. Is the proper place to get serious at the negotiating table in Geneva or in the news media?

Mr. Colby. Both.

Mrs. Byron. Both?

Mr. Colby. Both.

Mrs. Byron. Mr. Courter, do you have any questions?

Mr. Courter. Yes, I do, thank you, Madam Chair.

Obviously you are in favor, Mr. Colby, of a comprehensive test ban and you indicate that a comprehensive test ban will prevent modernization. I am wondering whether you can explain how a comprehensive test ban which prohibits the testing of nuclear devices will affect things such as accuracy improvements, penetration aids, chaff, jammers, et cetera, or would it?

### COMPREHENSIVE TEST BAN

Mr. Colby. Well, a nuclear test ban would not necessarily prevent those tests, it would prevent nuclear explosions, of course. That is what it is limited to.

Mr. **Courter.** But if the Soviet Union or the United States, with a comprehensive test ban wants to modernize in a sense of having more accurate warheads, having warheads that can penetrate the defense or penetrate Soviet or United States territory, those can obviously be accomplished even though there is a comprehensive test ban?

Mr. **Colby.** They could be accomplished under a comprehensive test ban. They could not be accomplished under a verifiable nuclear freeze agreement.

Mr. **Courter.** Do you believe that a comprehensive test—obviously you do, but I just want to hear you—do you believe that a comprehensive test ban is verifiable by national technical means?

Mr. **Colby.** I think so, yes sir. The information I have gotten indicates to me—I have taken most of this out of the public print in recent years—I have had some exposure to the subject in classified form but that is many years ago. I can only assume that our detecting devices have become more efficient, not less efficient in the last years.

You will notice also that the Soviets have offered to exchange detailed geological data about their areas.

Mr. **Courter.** I understand that they have not been very specific on the number of——

Mr. **Colby.** No, the limited Threshold Cest Ban Treaty calls for the exchange of data.

Mr. **Courter.** Well, have you been familiar with the position of many scientists that low yield nuclear explosions can be easily camouflaged. Have you heard that?

Mr. **Colby.** I have heard that.

Mr. **Courter.** Do you believe it?

Mr. **Colby.** Mr. Courter, I believe that the Soviets could not develop a comprehensive cheating scheme without our finding evidence of it. I am not talking about an odd explosion here and there. A deliberate program.

Mr. **Courter.** What you are saying is they could test and we would know about it?

Mr. **Colby.** They might test once but I suspect that we would begin to know about it and they would be taking a major risk.

Mr. **Courter.** You suspect that we would begin to know about it?

Mr. **Colby.** My point is that the intelligence machinery does not depend only on one particular sensor, one ability to find things. The whole concept of Central Intelligence is that one brings all of the relevant information to one center and then one makes a judgment. Now, that includes all sorts of information, not just a single bang.

Mr. **Courter.** Well, I have spoken to many scientists at our national laboratories and they have convinced me that a comprehensive test ban in fact is not verifiable, that you can detonate low yield nuclear weapons and warheads in special types of configurations, in holes where there is a great deal of airspace so the explosion can be cushioned or that different types of reverberations can be going on at the same time the test is and that we would have no level of confidence in verifying a comprehensive test ban.

Let me assume, if they are correct, that we would not necessarily be able to detect a Soviet violation in a comprehensive test ban, can you see a problem for the United States versus the Soviet Union in keeping any type of level of confidence in the capability of our deterrent forces?

I guess my question is if they test and we didn't, over a long period of time, what would that do to the concept of deterrence?

Mr. COLBY. I believe what we are discussing, the difference between the scientists and myself, is they are discussing one specific explosion, whether one specific explosion could be found out. What I am saying is that a comprehensive program we would identify by a variety of sources, that this is the nature of our intelligence coverage, it is not just one sensor that tells us the answer to these things.

I understand the technology of various hypotheses you put up—putting it in a chamber, all that sort of thing. The fact is any kind of major program of this sort we would begin to look at and try to find out what this is all about, and we would put all of our intelligence coverage on to that particular site and we would have a dozen hypotheses. Then we would ask the Soviets and demand an answer and by the combination of this kind of effort, I think we would be at least suspicious enough so that we would be free to denounce any activity and demand clarification which we have no right to do under present——

Mr. COURTER. Have you done that? I am sure you are familiar with the ample evidence, as far as I am concerned—maybe you have different conclusions—that the Soviet Union even while negotiating the 1972 chemical weapons agreement was in the process of modernizing its chemical and biological weapons capabilities, that they stand in clear violation of that agreement.

### VERIFICATION

Mr. COLBY. That agreement has no verification procedures, no enforcement procedures, it is one of what I call a sweetness and light agreement—the Chemical and Biological Treaty.

Mr. COURTER. We know. My point is, regardless of verification capabilities, written in the treaty, we know that they have violated it.

Mr. COLBY. Mr. Courter, you are saying that based on our intelligence coverage, right?

Mr. COURTER. That is correct. My point is what have we done about it? You are saying we are going to do something. They have violated a chemical weapons agreement, we didn't do anything about it.

Mr. COLBY. You are talking about our ability to find out whether they are violating it. You have already told me. Now, what you are asking is what should our policy actions be with respect to violations. That is a different subject than pure verification. That is a question of what policy we should undertake.

Mr. COURTER. I am probing in that particular area because obviously we have a difference of opinion on the verification of the comprehensive test ban. The scientists that I have spoken to have indicated to me that we cannot have a great deal of confidence in our ability to monitor their compliance with regard to the same. Your premise is that No. 1, that I am wrong, that we will be able to pick up any type of pattern of Soviet violation of the comprehensive test ban and that if we do, we will bring all sorts of pressure on the Soviets to make them comply.

We have all sorts of information indicating that they have violated other arms control agreements and they still haven't changed their behavior. Why would we be more concerned what we do differently if we knew they were violating another arms control agreement?

Mr. COLBY. Your question, Mr. Courter, gets to the heart of whether we should ever make an agreement with them. It doesn't get to the heart of our verifiability. Your evidence says that we can verify whether they are complying with the treaty or not. Your question says, if we find out that they cheat, we can't or don't or won't do anything about it. I think there are lots of things——

Mr. COURTER. It is a pretty basic concern, don't you think?

Mr. COLBY. I agree, and in the treaties like SALT I we have taken up apparent violations and achieved a change in action by the Soviets in certain cases, as I am sure you know.

On this chemical treaty, there is no provision, there isn't a standing consultative committee, there aren't provisions for carrying it out, and that is a flaw in the treaty.

I had a theory at one point—I don't offer this as a total solution to the problem—but we get into a subject, the discussion of violations, as though a violation is some particular problem in itself. We have lots of violations of domestic law, some are traffic tickets, some are misdemeanors, some are felonies, and some are capital crimes.

Similarly, I think we should be capable of working out an arrangement in a treaty by which the offended party denotes the seriousness of that particular violation and that then brings into the train certain required solutions to the problem, certain timeframes during which it must be answered, must be resolved, and all the rest of it. We then still end up with exactly where you stand today, that if you have a violation, what do you do about it, do you cancel the treaty? You have a perfect right to do so.

Mr. COURTER. Do you think we ought to do that with the chemical weapons agreement?

Mr. COLBY. If you feel serious enough.

Mr. COURTER. I am asking you.

Mr. COLBY. On the chemical weapons agreement, my knowledge is both we and they have very ample stocks of chemical weapons.

Mr. COURTER. The point is, we are both saying they violated the agreements. My question to you is should we withdraw from the treaty, is that your position or not? If not, why go along with the treaty?

Mr. COLBY. Well, I would like to look at each one. I would not withdraw from SALT I. I would not withdraw from the ABM Treaty, for instance.

Mr. COURTER. How about if they are violating the ABM Treaty, what you are telling me is we should comply with an agreement that they don't comply with.

Mr. COLBY. No, I am not saying that. I am saying that is your option at one point to denounce the treaty, of course. We are sovereign nations, both of us, and if you think that this is dangerous to our safety, then your position should be to denounce the treaty.

Mr. **Courter**. I know what my position is. I was trying to get yours.

Mr. **Colby**. My position is this does not seem to be sufficiently dangerous to the security of our country that we should denounce the treaty.

Mr. **Courter**. Let me go—I know my time has expired—may I ask one other quick question?

Mrs. **Byron**. Yes.

Mr. **Courter**. You said, Mr. Colby, in your statement, that it clearly may be—that is my word, not yours—it is in the best interest of both countries and that both countries want to eliminate nuclear weapons. What brings you to the conclusion that it would be in the Soviet Union's long term strategic interests, as a major player in the world, not to have massive military strategic strength?

Mr. **Colby**. If they could remove our nuclear strength, then I think it would be in their net interest, too. It would relieve them of the danger of being destroyed by our nuclear forces. It would relieve them of the necessity of putting up the kinds of defenses that they have against our nuclear forces.

Mr. **Courter**. Let me end with this: Do you agree or disagree with the statement that if the Soviet Union did not have nuclear weapons, that their influence in the world stage would be dramatically reduced?

Mr. **Colby**. No, I don't think it would. It is a great nation and it has a great army and it is getting an increasing navy, so that they have a military force. They have an ideological operation of considerable magnitude around the world, and I would anticipate they would retain that kind of relationship with the Cubans and the Nicaraguans and the Angolans and various others to the extent we allow them to do so.

That is my problem, that we are so fixed on this nuclear area that we are diverting ourselves from the real problems that we have and that we should be focusing on those kinds of problems instead of the nuclear.

If the Soviets had superiority in nuclear power, they would have used it. They don't because they know that that particular weapon is not rationally usable. Therefore, it is a waste of energy and effort to have, provided you can get both sides to get away from them.

Mrs. **Byron**. Mr. Spratt.

Mr. **Spratt**. No questions, thank you.

Mrs. **Byron**. Mr. Badham.

Mr. **Badham**. Thank you, Madam Chairman.

It is a pleasure to have you here, Mr. Colby.

I personally would like to change the direction just a little bit, after saying that I think your last statement was truly incredible, that if the Soviets had a superiority in nuclear weapons they would use them. I would just like to indicate my strong disagreement with that.

Mr. **Colby**. I said usable superiority.

Mr. **Courter**. Pardon?

Mr. Colby. A usable superiority.

Mr. Badham. I don't think you said that the first time.

Mr. Colby. That is what I am talking about.

Mr. Badham. We are very picky on absolute statements here. But I think that, not to use bumper sticker philosophy unnecessarily, but that bumper sticker says one nuclear weapon can ruin your whole day. I think that there is a great deal more truth in that than fiction. I grant that while we had a unilateral ending to the nuclear arms race for over a decade, the Soviets went right on producing more and more generations, as well as technical nuances up to the state of their ability, so we have kind of tried that, but I think that——

Mr. Colby. I do not stand for unilateral——

Mr. Badham. I know that, that is why this business of mutually verifiable arms freeze is a great euphorism. That is really all it is, because without verifiability—and I would challenge your statement that you can, we can verify—that is an absolute statement made to a very subjective situation. The very people who you claim have given us this great intelligence gathering ability, are the very ones that say we can't be sure on verifiability.

I think we ought to be involved in this committee and the great minds of today in crafting our attitudes for what you refer to as a postnuclear age. I think it is becoming evident that the United States, its leaders and its people agree that a nuclear exchange is the ultimate folly. I don't think there is much disagreement about that today.

I am also convinced that the people who live in the Soviet Union really don't add to or become part of this occasion at all, but the Soviet leadership I think is also convinced that a nuclear exchange at this time or any time now or in the future is the ultimate folly and there is no clear pattern of being able to win. Even if you destroy all of the other nations' nuclear weapons you probably destroyed the air and everything. I think we can all stipulate that. So what we have to do is craft an attitude for the possible postnuclear age.

You talk about patience in your statement. I think that the United States of America, in my view—I am about as privy as anybody else I guess to the information, the briefings classified and not, that do go on. We meet in this committee on frequent intervals with Ambassadors Kampelman, Tower, and Glitman. We have good perception and understanding of the Soviet negotiators' minds and they are to a degree intransigent.

I disagree with you and your comments that we reject things out of hand. I don't think serious proposals we do reject out of hand. Perhaps we reject unserious proposals too publicly, too quickly. That is a matter of semantics, but basically, I think that we have to recognize that we are entering the postnuclear age. We have to be able to prepare for that and preparing for that is not to take a thing as isolated but take a systems approach to the whole business of reducing the nuclear threat, because the nuclear threat is now a nuclear threat really in kind of name only.

On the comprehensive test ban, I just would like to quote Mr. Herbert York, physics professor at the University of California—San Diego, who as ambassador to the Comprehensive Test Ban

Treaty negotiations, said, "I need to add some qualifiers on my own position on the comprehensive test ban. One is that I don't think that a comprehensive test ban is a good thing as an isolated act. Comprehensive test ban in the world in which all of the other aspects of nuclear arms race are going forward in full gear obviously is unstable."

I am also persuaded by the people who are in the business of manufacturing, testing, and increasing the viability of nuclear weapons, who say that without verifiability you can't have it; and even with a comprehensive test ban treaty, you are putting yourself in a position where if somebody is cheating and they can test, they can keep their stockpiles viable; and if you do not test—and we always go on the letter as well as the spirit of the agreement—you can't insure the viability and stability of your shelf life stock.

So, again, thank you for your statement, and I can assure you that we, as a committee and a government, are trying to be patient and stable.

Thank you.

Mrs. BYRON. Mr. Ray.

Mr. RAY. No questions.

Mrs. BYRON. Mr. Mavroules.

Mr. MAVROULES. Thank you, Madam Chairman.

I want to thank both Mr. Colby and Dr. Sykes for appearing before us today. I think this is a very helpful exchange here this morning.

Let me give you my views on the comprehensive test ban because I was one of the original cosponsors of that. It would, in my judgment at least, stop these next generations of devastating nuclear weapons and, therefore, we have to get some controls as to where we are going for the future. We can talk about that day and night, however, because we have diverse views on that from both of you.

One thing that I would like to get into with you, Mr. Colby, is because of your intelligence background. All of us on the committee I believe, although we may disagree as to how we get there, we all agree on one thing that we must have is a verifiable package once it is agreed to. Would you recommend perhaps, or would you consider an international force as a basis for that kind of verifiability that would be effective between these great countries?

Do you think we have enough intelligence at this point or effectiveness to locate and distinguish a verification judgment, or for that matter, does the Soviet Union? Or do we have to go beyond and go to a third party perhaps that is impartial to guarantee the verifiability? Would you comment on that, please?

Mr. COLBY. I think, Mr. Mavroules, that we should depend upon ourselves fundamentally and that we should be satisfied that we can verify it sufficiently to justify going into it. There is no question about that. An international observation force could be supplemental perhaps, but I would not rest the safety of this country on any international force making a decision for me about verification.

Mr. MAVROULES. Mr. Courter brought out a good point. I think I agree with him. What steps do we take further down the line? Let us assume that we have a verifiable program in effect, they are breaking that agreement. What kind of public policy should we have with relation to a major break of the agreement? Would you like to comment on that once again? You were not too clear.

Mr. **Colby**. In a major breach of the agreement, I think we should consult with our allies. I think we should bring out the facts for the rest of the world to know and put such an international pressure through the U.N.—that is not very substantial—but such international pressure as we can develop through both diplomatic channels and public opinion channels aimed at pressuring them to stop that kind of behavior.

If this proves not to be workable, then I think we should give notice that unless the action stops that we are going to have to denounce at least a substantial portion of the treaty in question.

Mr. **Mavroules**. Let me just finish with one final question. Under a comprehensive test ban, of course we have diverse opinions on that. Do you feel that the position of the United States would be weakened whatever in view of our third generation versus six or seven generations of nuclear weapons?

Mr. **Colby**. I think our nuclear force is perfectly adequate today and I think it will continue to be for a long time to come. The real purpose of a comprehensive test ban is not to solve all the problems of nuclear weapons, it is to make a major step toward the solution of the remaining problems of nuclear weapons and——

Mr. **Mavroules**. How about the next generation in development of nuclear weapons?

Mr. **Colby**. It certainly would stop the next generation of nuclear weapons that were involved. It would not stop the vehicles by which they are carried. That is a defect that is a subject for other treaties.

Mrs. **Byron**. Would you yield?

Mr. **Mavroules**. Of course.

Mrs. **Byron**. Would this keep China or France or Libya or other nations for that matter, from testing nuclear weapons?

Mr. **Colby**. It would not automatically. It is a bilateral agreement, of course. But I think Madam Gandhi said the best thing about that one time when she said you superpowers don't give us any more lectures until you get your own arms race under control.

I think if we got our own arms race under control we would be in a situation where we could jointly, as we have in the Nonproliferation Treaty, try to limit the spread of these weapons.

Mr. **Mavroules**. Thank you.

Mrs. **Byron**. Let me say that Dr. Sykes, we will hear your testimony now. Then we will go back and question both of you. I think Mr. Spratt had a few questions and Mr. Ray will probably have some at that time.

## STATEMENT OF DR. LYNN R. SYKES, PROFESSOR OF GEOLOGICAL SCIENCES, LAMONT-DOHERTY GEOLOGICAL OBSERVATORY, COLUMBIA UNIVERSITY

Dr. **Sykes**. All right, thank you, Chairman Byron, members of the committee.

I address you today as a scientist who has been involved in the detection and identification of the testing of nuclear weapons for the past 24 years. I am the Higgins Professor of Geological Sciences at Columbia University. I was a member of the U.S. delegation that negotiated the Threshold Test Ban Treaty with the Soviet Union in 1974. I have been a member of several U.S. Government panels that have examined questions of verification of atomic testing. I am presently a member of a scientific panel for the Department of Defense that examines methodology for estimating the yields of Soviet explosions. I am a member of the U.S. National Academy of Sciences and the American Academy of Arts and Sciences.

Seismology, my main field of expertise, provides the main tools for verification of a comprehensive test ban treaty, for ascertaining if the Soviet Union has complied with the 150 kiloton limit set by the Threshold Test Ban Treaty and for making accurate estimates of the sizes of Soviet atomic tests and of weapons emplaced on Soviet strategic systems.

Let me first give you a statement of the major points I wish to make in my testimony:

First. A comprehensive test ban treaty is verifiable with high confidence down to explosions of very small size. The lower limit of reliable identification can be reduced to about 1 kiloton with a combination of seismic listening posts within the U.S.S.R. and other national technical means such as satellite photography. Recent advances in seismology ensure that attempts to detonate clandestine explosions under the comprehensive test ban treaty will be even easier to detect than was thought only a few years ago.

Second. An alternative to a comprehensive treaty, is a low yield threshold test ban treaty with a threshold limitation of about 1 or a few kilotons. A low yield threshold treaty or a comprehensive test ban treaty would drastically curtail the testing and development of a so-called third generation of new atomic weapons.

Third. There is now near scientific unanimity on the methodology of correctly estimating the sizes and yields of Soviet explosions. When this methodology is employed, it is evident that the Soviet Union has not violated the 150-kiloton limit of the Threshold Test Ban Treaty. Both the U.S.S.R. and the United States have tested repeatedly near that limit since the treaty entered into force in 1976.

Fourth. It is in our national interest that the Soviet Union not test very large nuclear weapons and thence emplace more lighter weight weapons on their large intercontinental missiles. The Threshold Test Ban Treaty and SALT II have constrained the number of intercontinental missiles deployed by the U.S.S.R. and the sizes of the nuclear weapons carried by those systems.

In the absence of such restraints, the U.S.S.R. would probably have an asymmetrical advantage in that it could conduct very large underground tests easier than the United States and deploy weapons of greater yield on greater numbers of their large ICBM's.

Fifth. Both the Threshold Test Ban Treaty and the Peaceful Nuclear Explosions Treaty can be verified with high confidence. U.S. ratification of both of those treaties would constrain the U.S.S.R. by treaty from conducting large nuclear weapons tests.

Sixth. Seismic data now provide accurate estimates of the sizes of large Soviet weapons tests that were conducted in the 10 years prior to the Threshold Test Ban Treaty, that is prior to 1976. The sizes of those tests can be used to estimate the yields of nuclear weapons that were emplaced on Soviet strategic systems in the late 1970's. When those yields are estimated, with a correct methodology, they are lower than many other published estimates. Hence, the total megatonnage of U.S.S.R. strategic systems does not appear to be much larger than that for U.S. systems, as has often been claimed.

Seventh. The main impediments to a comprehensive test ban or a low yield threshold test ban treaty are neither scientific nor technical but rest on the notion that the security of the United States is best enhanced by continued testing and development of new atomic weapons.

## VERIFICATION OF A COMPREHENSIVE TEST BAN TREATY

Active interest in the comprehensive test ban is now more than 30 years old. A comprehensive test ban, which still does not exist today, is one of the longest running issues on the arms control agenda. The nuclear freeze proposal, House Joint Resolution 3 and the summit meeting have heightened public and congressional interest in taking steps to avoid nuclear war. A ban on atomic testing has been a major component of various freeze proposals.

The field of seismology provides the main tools for the detection of underground atomic testing, for the identification of signals of an event as being those of either an underground test or those of an earthquake. Most seismologists who have been involved in test ban research, like myself, conclude that the main technical and scientific impediments to verifying a comprehensive test ban were solved between 1963 and 1970. Since that time, the capability to detect small explosions and to identify or discriminate their signals from those of small earthquakes has steadily improved.

The United States has conducted an extensive program to improve the detection of nuclear tests for 26 years. We have spent about one-half of $1 billion in this endeavor; more than a billion dollars has been spent worldwide. Seismic methods for identifying nuclear testing improved greatly during that period as a result not only of funds spent specifically for that purpose, but also as a result of the more than $3 billion or $4 billion that is spent annually by the petroleum and mineral industries and by various Government agencies on the acquisition of seismic data and on improved seismic methods.

Seismology has grown from a small, relatively weak field in the late 1950's to one that now provides considerable knowledge in the search for new energy and mineral resources and in the development of better methods and instruments for verifying a comprehensive test ban.

Extensive negotiations toward a comprehensive test ban were conducted among the United States, the United Kingdom, and the Soviet Union from 1977 to 1980. All of the long contested aspects of verifying such a treaty were resolved, at least in principle, by 1980, including a moratorium on the testing of peaceful explosions, provisions for U.S. seismic monitoring posts within the U.S.S.R., international exchange of seismological data, and on-site inspections of the challenge type. Those negotiations have been in recess since 1980.

In July 1982 the New York Times and other newspapers carried the story that the United States Government had decided not to continue test ban negotiations with the U.S.S.R. and the United Kingdom. Three reasons were cited for the decision:

First. A lack of adequate seismic methods for verifying a comprehensive treaty.

Second. An assertion that the Soviet Union either had or may have cheated repeatedly on the Threshold Test Ban Treaty by detonating explosions above its 150-kiloton limit.

Third. The security of the United States is best enhanced by the rapid development and testing of new atomic weapons.

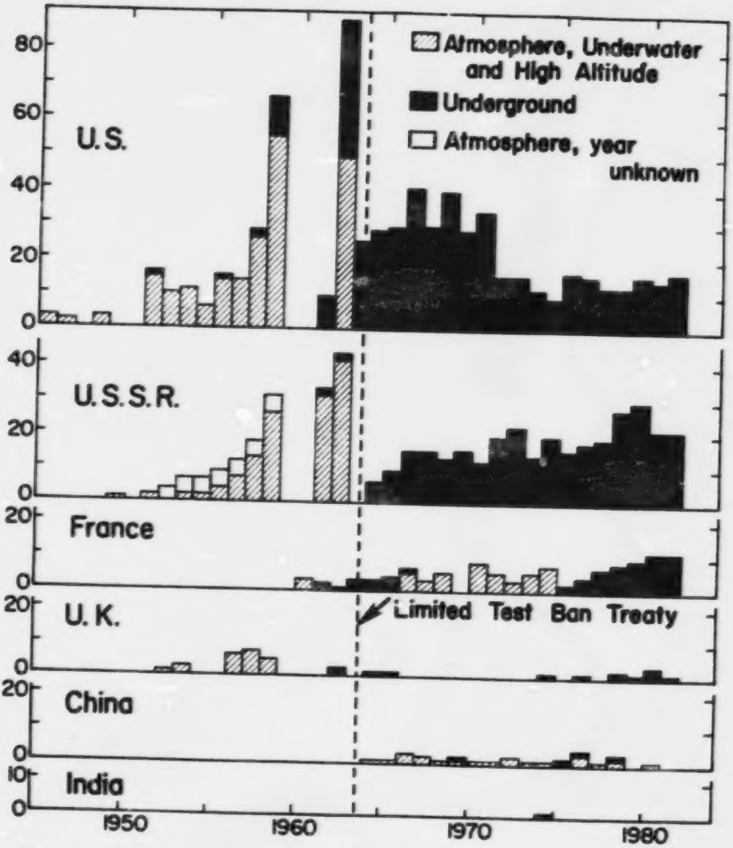

Figure 1. Number of explosions by six nuclear powers. Note that Limited Test Ban Treaty of 1963 did not put an end to atomic testing but merely drove testing underground by signatories to treaty.

Figure 1 shows the yearly number of nuclear tests conducted by the six countries that detonated atomic weapons between 1945 and 1982. The Limited Test Ban Treaty of 1963 had a positive effect in that the United States, the U.S.S.R. and United Kingdom, all of which signed the treaty, did not test in the atmosphere after 1963. The Limited Test Ban Treaty put an end to the testing of very large weapons; that is, those of tens of megatons. It clearly did not put an end to nuclear testing itself, which merely went underground after 1963.

The Limited Test Ban Treaty had another negative effect in that public interest in test bans diminished greatly after 1963. Tests in the atmosphere, with attendant fallout and mushroom-shaped clouds, were a much less abstract phenomenon to most of the public than tests underground.

The number of weapons tests from 1963 to 1985 greatly exceeds the number of tests prior to 1963. About 10 to 20 percent of the tests conducted by the U.S.S.R. since 1974 have been peaceful nuclear explosions. The United States has not conducted peaceful nuclear explosions since 1973. It is evident from figure 1 that the United States and the Soviet Union have conducted by far the greatest numbers of tests.

Figure 2 shows the sizes of nuclear weapons that have been tested thus far. By examining the yields of United States and U.S.S.R. underground tests from 1963 to 1985, we find that both countries detonated a comparable number of tests of intermediate yield and a similar number of larger tests. The largest underground test to date had a yield of about 5,000 kilotons and was conducted by the United States in the Aleutian Islands in 1971.

In the attached preprint of a paper by Sykes & Wiggins, we estimated the sizes of the largest Soviet underground tests for the time period before the Threshold Test Ban Treaty entered into force in 1976. A careful calibration by different methods indicates that the largest Soviet underground explosion had a yield of about 3,500 kilotons, somewhat smaller than that of the largest United States underground test.

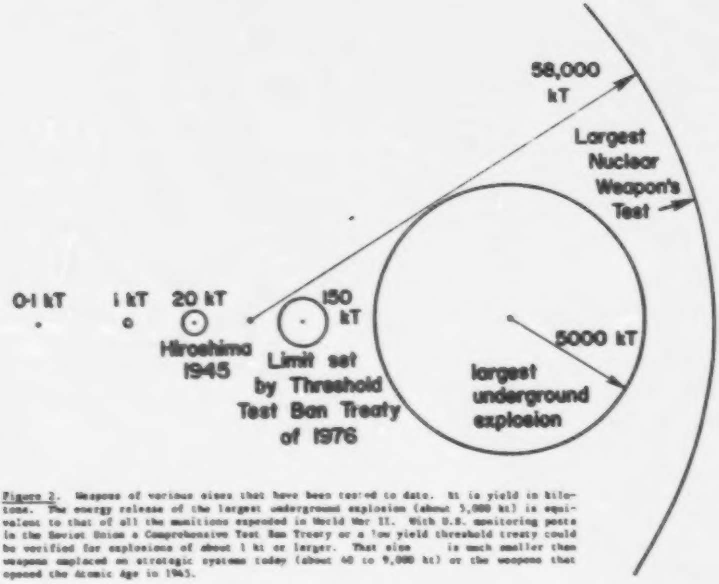
58,000 kT
Largest Nuclear Weapon's Test
0·1 kT
1 kT
20 kT
Hiroshima 1945
150 kT
Limit set by Threshold Test Ban Treaty of 1976
5000 kT
largest underground explosion

Figure 2. Weapons of various sizes that have been tested to date. kt is yield in kilotons. The energy release of the largest underground explosion (about 5,000 kt) is equivalent to that of all the munitions expended in World War II. With U.S. monitoring posts in the Soviet Union a Comprehensive Test Ban Treaty or a low yield threshold treaty could be verified for explosions of about 1 kt or larger. That size is much smaller than weapons emplaced on strategic systems today (about 40 to 9,000 kt) or the weapons that opened the Atomic Age in 1945.

Figure 2 shows the great range in the yields of atomic weapons that have been tested thus far. One kiloton is equivalent in energy release to that of 1,000 tons of TNT. The sizes of weapons that opened the Atomic Age in 1945 were about 12 to 22 kilotons. With the advent of the hydrogen bomb in the 1950's, weapons of much larger yield were tested. The largest weapon tested thus far was the 58,000-kiloton Soviet explosion of 1961 in the atmosphere at their Arctic test site.

Some measure of the size of nuclear weapons can be realized from the fact that 5,000 kilotons, the approximate size of the largest underground explosion to date, is somewhat greater in explosive power than all of the munitions expended in World War II. Announced yields of weapons carried by intercontinental ballistic missiles are in the range of 40 to 9,000 kilotons. Both the U.S.S.R. and the United States have deployed about 18,000 strategic weapons of that size range. While the Threshold Test Ban Treaty put an end to the testing of larger weapons in that range, it did not limit the testing of all weapons carried by intercontinental missiles.

## VERIFICATION OF A COMPREHENSIVE TEST BAN TREATY BY SEMISMIC METHODS

The main problem in seismic verification of a comprehensive test ban has been to distinguish the signals of small explosions from those of the many small earthquakes that occur around the world every year. The location of a seismic event, its depth below the surface of the Earth, and pronounced differences in the frequency content of signals from underground explosions and earthquakes, provide powerful methods for identifying a given signal as being either that of an earthquake or underground test. These methods are described in more detail in the attached paper from Scientific American of October 1982 by Sykes and Evernden and in my testimony of May 8, 1985, before the Subcommittee on Arms Control, International Security and Science, of the House Committee on Foreign Affairs.

Seismological methods will always have some lower limit of detection or of identification, regardless of the seismic network used for surveillance. Our work and that of many others indicates that the signals from underground explosions and earthquakes can be distinguished with very high reliability down to a certain lower limit. That lower limit depends critically upon whether a treaty on atomic testing would allow United States seismic stations in the Soviet Union and on what attempts might be made to hide illegal tests. Results for these various possibilities are given in table 1.

TABLE 1.—THRESHOLDS IN KILOTONS FOR RELIABLE IDENTIFICATION OF UNDERGROUND NUCLEAR EXPLOSIONS USING SEISMIC NETWORKS EXTERNAL AND INTERNAL TO U.S.S.R.

| | External net alone | Internal plus external net |
|---|---|---|
| 1. Hard rock or below water table (no evasion attempts, fully coupled) | 1 | 0.1 |
| 2. Detonation in low coupling material. Dry, porous alluvium | [1] 1-2 | 1 |
| 3. Detonation in large underground cavity in salt dome | [2] 10 | [3] 1 |

[1] Limited by maximum thickness of unsaturated alluvium in U.S.S.R.

[2] Limited by maximum sizes of large underground cavities that can be constructed clandestinely and maintained without collapse.

[3] Approximately.

When the trilateral test ban talks were recessed in 1980 the U.S.S.R. had agreed to allow United States seismic listening posts on its territory and the United States had agreed to allow Soviet stations on our territory. Line 1 of table 1 indicates that a good external seismic network has the capability of verifying underground testing with yields of 1 kiloton or larger for well coupled explosions, that is, the case in which no attempt is made to muffle, disguise, or hide the seismic waves generated by an underground test. That limit drops below 0.1 kilotons if stations internal to the U.S.S.R. are added to the external network.

Several different evasion or cheating possibilities have been discussed extensively for many years. They include detonation of explosions in low-coupling materials, the most extreme possibility being explosions detonated in dry, porous, alluvium, that is, dry gravel and sand, detonation of explosions in very large underground cavities, timing underground explosions to occur soon after large earthquakes, such that their signals would be hidden or masked, and setting off several explosions with small time delays so as to make certain waves look more earthquake-like.

The detonation of underground explosions in a low-coupling material has been discussed for many years. The intent here would be to produce very small seismic waves for an explosion of a given size. Many misleading statements have been made about this possible method of clandestine testing. It is very important to remember that while it may work for the U.S.S.R., it is limited to explosions of very small size.

For example, the thicknesses of dry, porous alluvium in the U.S.S.R. do not permit contained tests in that medium larger than 1 to 2 kilotons. That sets the limit for the external network in line 2 of table 1. Augmenting the external network with stations internal to the U.S.S.R. reduces that cheating possibility to one kiloton or smaller. The use of that evasion scheme, even at very low yields, is very risky since dry, porous alluvium is easily disturbed. Any significant surface disturbance would be observed easily with satellite photography.

Most of those specialists who have worked on the verification of a comprehensive test ban treaty are in agreement that the denotation of explosions in very large cavities represents the most significant evasion possibility. It sets the overall limit on the size of explosions that might not be positively identified as such under a comprehensive test ban if the U.S.S.R. were to make its best attempts to cheat on the treaty. That scenario is mentioned extensively in the various testimony presented to your committee on September 18, 1985.

I think that big hole evasion has been seriously overrated for a number of reasons. The volume of rock that must be excavated to fully decouple an explosion of about eight kilotons is approximately equivalent to the volume of the largest Egyptian pyramid, a fact that pessimists about verifying comprehensive test ban usually forget to mention. Most of the work in the United States and United Kingdom on this topic is now 20 to 30 years old. United States and British experiments of 25 years ago with conventional

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explosives indicated that the decoupling idea does work for explosions of a few tons.

The United States detonated one underground explosion named Sterling in a salt dome in Mississippi to test the decoupling theory. At that time, it was the policy of the U.S. Government to emphasize verification by methods that could be used at intercontinental distances, that is, with stations external to the U.S.S.R. That assumption, as well as data from the Nevada Test Site, suggested at the time that seismic waves would not be observable for frequencies higher than 1 to 2 hertz, that is, 1 to 2 cycles per second.

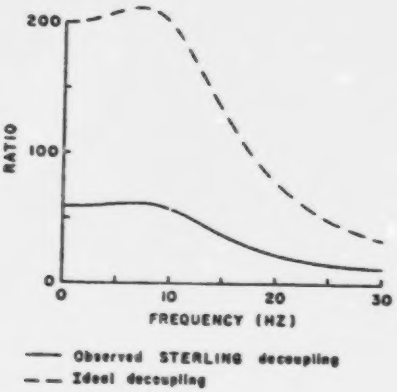

Figure 3. Decoupling ratio (amount of muffling of seismic waves) for the detonation of the STERLING nuclear explosion (0.4 kilotons) in a large underground cavity. Note that observed muffling is not as great as predicted by theory and that amount of muffling (solid line) is not as great at high frequencies as at low frequencies.

Figure 3 indicates that a muffling ratio of 200 was predicted theoretically at those frequencies. The observed ratio was about 60. Theoretical calculations indicate that the amount of muffling is much less at higher frequencies; that is, 15 or 30 Hz. Thus, if we could obtain a high frequency monitoring capablity for much of the Soviet Union, cheating possibilities using large underground cavities would be much more serverely limited.

In the last few years it has been recognized that high frequency seismic waves propagate readily across large parts of the Soviet Union. This represents an important advance in our capability to verify a comprehensive test ban. Several of those who testified before this panel on September 18 including the Director of the Lawrence Livermore Laboratory and Dr. Ralph Alewine of the Defense Advanced Research Projects Agency, emphasized the potential promise of high frequency signal detection. I believe that reality lies somewhere between the technique being merely one of potential but unproven promise and one that has been fully perfected.

A great deal of seismic data has been obtained in Europe and Asia, including large parts of the U.S.S.R., for seismological studies of the crust of the Earth and for exploration for petroleum and minerals. Those data are very good for frequencies from 1 to about 10 Hz. In addition, high frequency data have been analyzed from several of the seismic arrays operated by the United Kingdom and from several of the sophisticated stations operated by the United States Department of Energy as a test of instruments that could be deployed in the U.S.S.R. under a test ban treaty.

Those data generally indicate propagation of high frequency waves with good signal to noise ratios from small explosions in continental areas of older geology. A high percentage of the U.S.S.R. consists of older geological areas.

Extensive data have now been collected by the Norwegian seismic array from explosions in several parts of the the U.S.S.R.

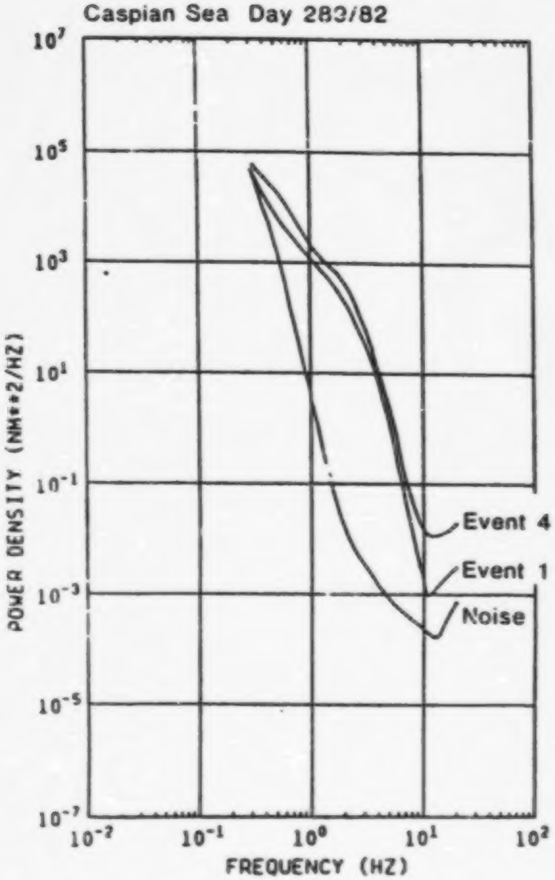

Figure 4. Sizes of seismic waves (vertical axis) as a function of frequency for 2 underground explosions at Azgir test site of U.S.S.R. to the north of the Caspian Sea. Note that the signal levels for both events are well above the noise level for all frequencies up to 20 Hz (cycles per second).

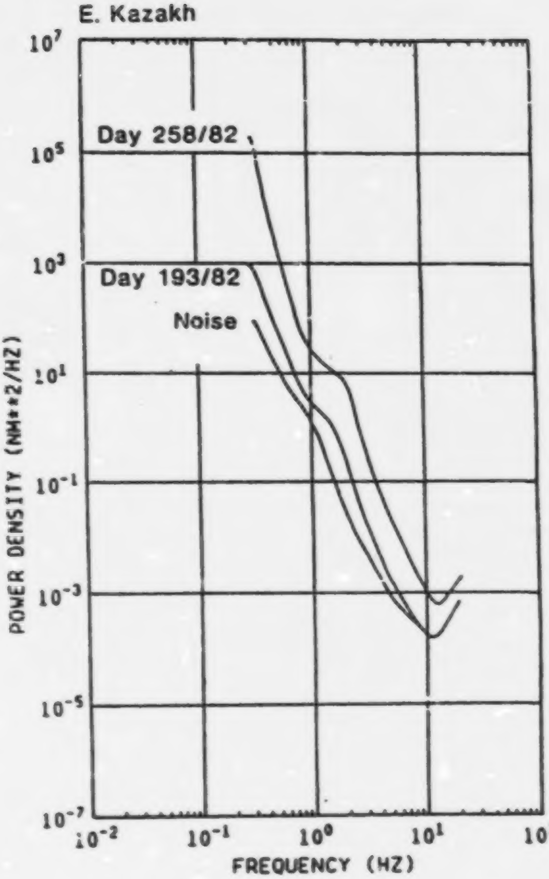

Figure 5. Similar date as in Figure 4 but for 2 underground explosions of very small size at Soviet test site in Central Asia at eastern Kazakhstan. Data for Figures 4 and 5 are from Semi-Annual Technical Summary for Norwegian Seismic Array.

Figures 4 and 5 illustrate sizes of seismic waves as a function of frequency for small explosions at the test sites in Central Asia in Kazakhstan. The two underground explosions at Azgir have yields of about 10 to 20 kilotons while the two explosions from Central Asia have yields of approximately one half and one to two kilotons respectively. Note that all except the smallest event have signal levels that are larger than the noise levels for signal frequencies as high as 20 Hz.

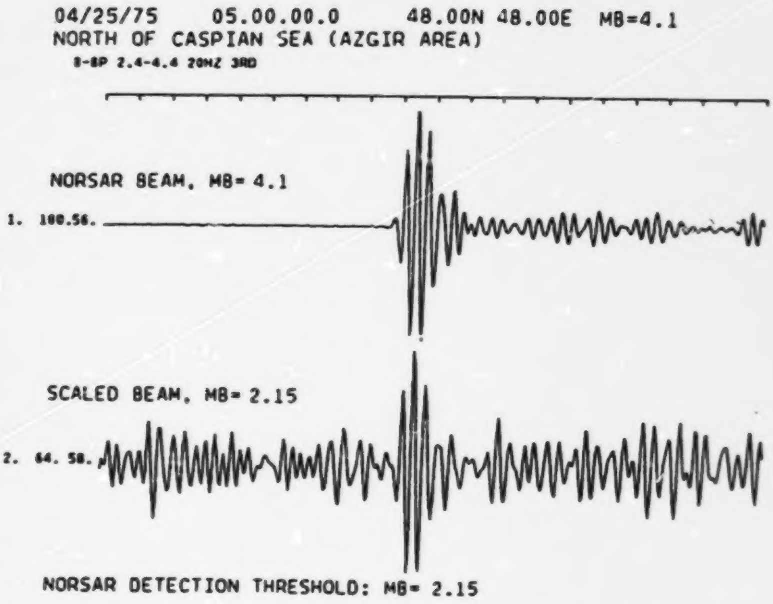

Figure 6. Seismic waves recorded at Norwegian seismic array for very small explosion at Azgir test site (upper seismogram). Note large size of seismic waves compared to small noise level preceding the event. Lower trace shows a scaling experiment to indicate at what size an event would be detectable in the presence of noise. Lower trace indicates that an event of $m_b$ 2.15 can be clearly seen. $m_b$=2.15 corresponds to an explosion of about .01 kilotons in hard rock and a few tenths of a kiloton fully decoupled in a large underground cavity. From Semi-Annual Technical Summary for Norwegian Seismic Array for 1984.

The upper seismogram of figure 6 indicates the processed output from the Norwegian array from a small event with a yield of about 1 to 2 kilotons at Azgir. It can be seen that the signal is much, much larger than the noise proceeding it. In their semiannual technical summary, the Norwegians indicate the sizes of events on the seismic bodywave magnitude ($m_b$) scale that could still be well detected in the presence of noise. The lower trace of figure 6 shows that a signal can still be readily detected from an event as small as magnitude $m_b = 2.15$.

In his testimony of September 18, Dr. Alewine estimates that "if the verification objective is to detect all nuclear tests as small as 1 kiloton or more, it now appears that a detection threshold of about magnitude 2.5 is required." I believe that Dr. Alewine's number is too pessimistic and that a more reasonable estimate is about $m_b$ 2.8 to 3.2 for various parts of the U.S.S.R. Nevertheless, it is clear that high frequency seismic waves and the use of other national technical means can reduce the possibilities of clandestine testing to explosions of a very small size.

TABLE 2.—*Detection thresholds for seismic events in various parts of U.S.S.R. using high-frequency data from Norwegian Array*

| | *Bodywave magnitude* |
|---|---|
| West of Ural Mountains | 2.0–2.5 |
| Caspian area | 2.0–2.5 |
| Semipalatinsk | 2.5–3.0 |
| Siberia | 2.5–3.5 |

Note: from NORSAR, Semiannual Technical Summary, Apr. 1–Sept. 30, 1985.

It should be remembered that the Norwegian data were taken along paths that were 1,800 to 2,600 miles from the Azgir and Central Asian test sites respectively. United States seismic listening posts within the U.S.S.R., if they are equipped for a high-frequency capability, would allow greater areas of the Soviet Union to be monitored and at closer distances, undoubtedly, there will be some areas of the U.S.S.R., particularly in the vicinity of Lake Baikal and along the southern borders of the U.S.S.R., for which it is likely that high frequency seismic waves do not propagate efficiently. Evasion opportunities could be reduced by placing more U.S. seismic monitoring posts in those areas and by making sure that external stations are available near the southern borders of the U.S.S.R.

Another possible method of evasion that has been discussed extensively is the so-called hide-in-earthquake scenario. The idea here is to detonate a small explosion soon after a large earthquake such that its signals will be masked or covered by those of the larger earthquake. This scenario has a major disadvantage in that nuclear weapons must be kept in readiness in a totally clandestine manner for long periods of time awaiting an earthquake of sufficient size. A very sophisticated seismic network would be needed to tell immediately that the earthquake was in fact of large enough size. Hence, the opportunities for using this method of evasion are limited to small explosions.

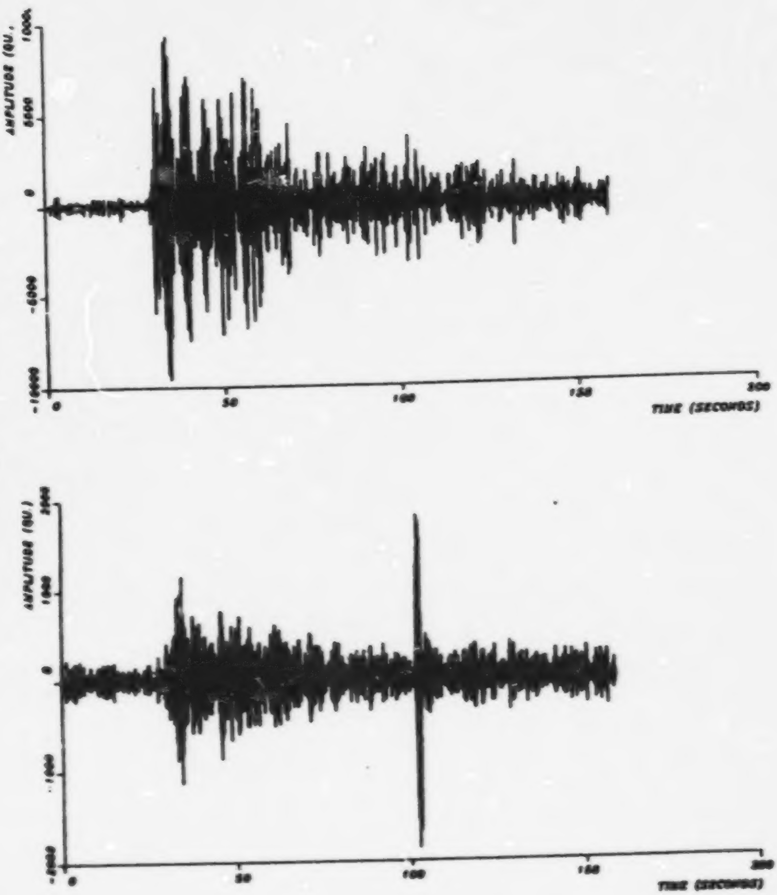

Figure 7. Example of recordings made by Norwegian seismic array of a large earthquake that arrives at a time of 30 seconds followed by a very small underground nuclear explosion at eastern Kazakhstan test site of U.S.S.R. Upper record is made with standard band of frequencies between 1.2 and 3.2 Hz. Lower trace, which clearly shows large high-frequency signal from small undergound explosion, is made with a passband of 3.2 to 5.2 Hz.

Figure 7 shows another use of high frequency seismic monitoring, in this case for detecting small explosions detonated at or near the time of large earthquakes. The upper seismogram shows a conventional recording with low frequencies. It and the lower figure show the arrival of waves from a large earthquake in the eastern part of the U.S.S.R. at a time of 30 seconds. The lower recording is of higher frequency waves. It shows a very large high frequency arrival soon after a time of 100 seconds. That second event, which is not very evident on the upper trace was an explosion of about one half a kiloton from the Central Asian test site of the U.S.S.R. So it is evident then that hiding in an earthquake, while we must give some credence to it, is one that is going to be limited for very tiny explosions.

While it is certainly possible to construct an underground cavity sufficient to decouple, say, one-tenth of a kiloton, the construction of larger cavities in any rock other than salt would be easily detected by satellite photography and other national technical means. Thus I believe a monitoring capability to very low magnitudes such as the figure of magnitude 2.5 that Dr. Ralph Alewine of the Defense Advanced Research Project Agency indicated on September 18 does not need to be obtained for the entire territory of the Soviet Union, but only for those areas of thick uniform sequences of salt.

An as yet unresolved aspect of monitoring a comprehensive treaty is the required magnitude or yield threshold of the monitoring network. In conjunction with testimony before the House Armed Services Committee in 1978, Dr. Harold Agnew replied in a letter, "I don't believe testing below, say, 5 to 10 kilotons can do much to improve as compared to maintaining strategic posture."

In a recent article entitled "Militarily Significant Nuclear Explosive Yields," R.E. Kidder of the Lawrence Livermore National Laboratory plotted an histogram of the number of recent U.S. explosions as a function of yield or size.

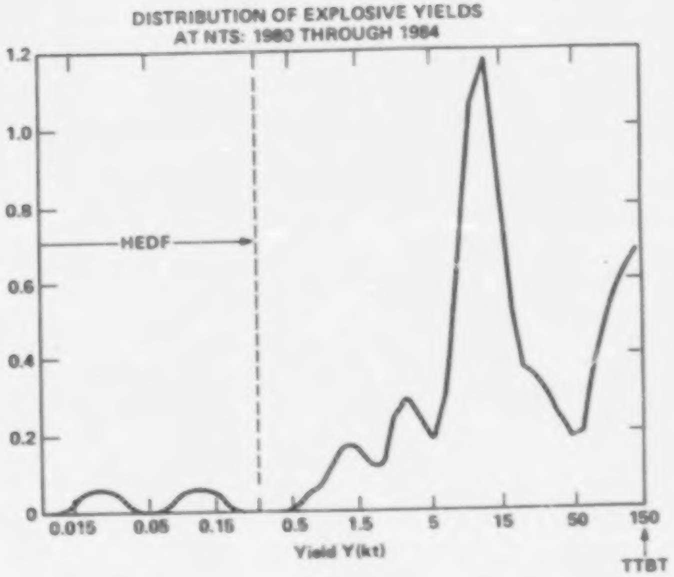

Figure 8. Histogram (vertical axis) of number of recent underground explosions at Nevada Test Site as a function of yield (horizontal axis) in kilotons (kt). From R. E. Kidder, Journal of the Federation of American Scientists (FAS), vol. 38, no. 7, September 1985.

His diagram is reproduced in figure 8. It can be seen there are major peaks in the frequency of tests with yields of about 12 and 150 kilotons.

Soviet tests for the same periods show a similar distribution.

Kidder states that only 5 percent of our tests were of yields less than 1 kiloton and 18 percent were of yields less than 5 kilotons.

Thus for the time interval that he examined, the military significance of tests below 1 kiloton was perceived to be very low by those conducting the testing program, those below 5 kilotons relatively low, and those near 12 and 150 kilotons were regarded as high.

It has been argued that a full test ban would give the Soviet Union an asymmetrical advantage in that they might conduct very small, clandestine tests whereas the United States could not. I believe that an alternative to a comprehensive treaty could well be a low-yield threshold treaty with the limit set by the capabilities for reliable verification.

United States stations within the Soviet Union and use of other monitoring methods would provide an opportunity for reliable monitoring down to levels of about 1 kiloton.

A threshold limitation of 1 to 5 kilotons would thus eliminate about 82 to 95 percent of the testing that has been conducted by the two superpowers during the past 5 years.

Let me say a few words about Soviet compliance with the threshold test ban treaty.

### SOVIET COMPLIANCE WITH THE THRESHOLD TEST BAN TREATY

Over the past few years, various officials of the United States Government have stated that the Soviet Union is likely to have violated this treaty by testing above its 150-kiloton limit. Last spring the Subcommittee on Arms Control, International Security and Science, of the House Foreign Affairs Committee, heard testimony on this subject in conjunction with House Joint Resolution 3. I and a number of other seismologists familiar with the estimation of yields of Soviet explosions by seismic methods have long argued that the United States Government uses an incorrect method for seismic calibration that overestimates the size of Soviet explosions.

A great deal of new scientific work in this subject using many different techniques has been completed in the last year. The result of those seismological studies all indicate that the current methodology, using only certain short-period seismic waves, contains a systematic calibration error that results in overestimates of yields of Soviet tests unless the calibration is done correctly.

The yields of explosions at the Central Asian test site of the Soviet Union have now been calibrated using six methods that I list in my testimony on page 31.

I believe there is now near scientific unanimity on the correct methodology for estimating yields of Soviet explosions and of uncertainties in yield estimates.

If these methodologies are employed, it is evident that the Soviet Union, like the United States, has tested repeatedly close to the limit of the threshold treaty since 1976, but has not tested significantly above it. It is my understanding that a panel of the Defense

Intelligence Agency has recently reviewed these methods of estimating yields and has completed a classified report on that subject.

I would urge this committee in writing its report that I understand that it intends to do, to consult that document as well as two classified documents that have been prepared by the Defense Advanced Research Projects Agency, and another one by the Air Force Technical Applications Center.

Let me say a few words about the disadvantage to United States security by not restraining Soviet tests.

I believe that relatively little attention has been paid to this in conjunction with the threshold treaty.

For example, the Soviet Union could resume the testing of weapons larger than 1 megaton or 1,000 kilotons relatively easily while the United States could not do so very quickly or easily, if the threshold treaty were not to be continued. That treaty and the peaceful explosions treaty provides a means for the United States to maintain its technological lead in strategic systems.

My estimates indicate that the weapons that were tested by the Soviet Union in the period just before the threshold treaty went into effect and were placed on Soviet strategic systems in the following few years have lower yield-to-weight ratios, in other words they are heavier, than those for comparable American systems.

Thus it is certainly not in the best interests of the United States to have the Soviet Union conduct weapons testing to full yield of lighter weight weapons of say 500, 1,000, or 2,000 kilotons.

They have not conducted such tests since 1975, 10 years. Ratifying the Threshold Treaty would restrain them by treaty from doing so again.

### SIZES OF WEAPONS ON SOVIET STRATEGIC SYSTEMS

In examining Soviet compliance with the Threshold Treaty, we discovered that Soviet testing practice since that treaty took effect in 1976 is to detonate many weapons of a few specific yields. Sykes & Wiggins in a document attached as an appendix to my testimony, reexamined the yields of the largest weapons tested by the Soviet Union from the start of their underground testing program in the 1960's until the Threshold Treaty entered into force in 1976.

Figure 2 from that document shows that the large weapons tested from 1962 to 1976 at the Arctic test site of the Soviet Union are clustered into a few specific peaks or yields of which 500 kilotons is the predominant or dominant peak.

MIRV'd versions of the Soviet SS-17, SS-18, and SS-19's became operational in the late 1970's soon after those large tests were conducted by the Soviet Union.

Our estimates of 500 kilotons for the sizes of the weapons that are emplaced on those systems in the late 1970's are among the lowest that have been published or given in congressional testimony.

For example, Paul Nitze in his congressional testimony of July 12, 1979 in conjunction with SALT II gives the yields of the weapons on those three systems as 750 kilotons, 1.5 times what I have estimated.

The MIRV'd versions of those three Soviet systems account for a very large percentage of the total megatons of Soviet capability that can be delivered at intercontinental distances. Hence, correct estimates of yields of those and other weapons have a considerable impact on the calculations of lethality of Soviet weapons and of their total megatons.

A number of other sources give yields that are even larger than those of Nitze and hence, portray the Soviet Union as having more powerful weapons than the United States.

My estimates of the total megatonnage indicates that for the Soviet Union it is only slightly greater than that for the United States.

In summary, I have argued that a comprehensive treaty can be verified with high reliability down to explosions of very small size, even given the best attempts to cheat on the part of the Soviet Union.

By employing United States seismic listening posts within the Soviet Union and other surveillance methods, it should be possible to monitor a test ban with high reliability down to explosions of about 1 kiloton.

An alternative to a comprehensive treaty would be a low yield threshold treaty with a threshold of one to a few kilotons.

Of United States or Soviet tests conducted in the previous 5 years, only about 5 percent were of yields smaller than 1 kiloton.

While verification is obviously of great importance to the United States and we must make a major and determined effort in verification if we are to sign a comprehensive treaty, the major question facing us in this area as a nation is whether our national security is best enhanced by a program of rapid development and testing of new atomic weapons or by strenuous attempts to reach bilateral, verifiable, and equitable arms control agreements with the Soviet Union.

We need to make sure that correct scientific methodology is used in estimating not only the sizes of Soviet tests under the threshold treaty, but of weapons that were tested before that and have been emplaced on Soviet systems. In both of those areas, there has been a considerable tendency to overestimate the sizes of Soviet tests and the yields of deployed Soviet weapons.

Policymakers have been and continue to be seriously misled on these issues.

I believe it is clear in comparing testimony that was given last spring and September 18 that there is continuing controversy over several matters that——

Mrs. BYRON. Excuse me for interrupting, we have a vote on the floor and I kept thinking you were almost through summing up but if you are not, I think we will have to be excused for about 10 minutes and we will be right back.

Dr. SYKES. Right, thank you.

Mrs. BYRON. It kept looking as though you were almost there.

Dr. SYKES. I was in my last paragraph.

Mrs. BYRON. We will be right back.

Dr. SYKES. Thank you.

[Recess.]

Mrs. BYRON. Would you like to do your wrapup, Dr. Sykes.

Dr. **Sykes.** Thank you.

I have one paragraph.

I believe it is clear in reviewing the different testimony given to this and other committees that there is continuing controversy over several matters that involve large scientific and technical components. Some of these would include: Can the U.S. stockpile of existing atomic weapons be counted on to work into the future? Two, has too much emphasis has been placed on the development of lightweight weapons at the expense perhaps of robust design and long life. Has the Soviet Union cheated on the Threshold Treaty? To what lower limit can a comprehensive test ban be verified reliably. And how much credence should be given various cheating schemes?

I think a serious question that we should ask and that is why has a consensus opinion not taken hold. We have long had arguments on these issues.

Another major question is does Congress want to be informed about the relevant technical and scientific issues. If the answer to the latter is yes, I would advise that three steps be taken. One would be to obtain the classified documents by the three agencies that I mentioned before that have studied the question of Soviet compliance with the Threshold Treaty and yield estimation; ask the National Academy of Sciences or the Office of Technological Assessment to conduct a review of these issues; and third, to ask the Congressional Research Service to provide expertise on these matters which they presently mostly lack.

I believe it is only in these ways that checks and balances could be provided to the conflicts of interest that are inherent with regard to these issues by several Government agencies. Thank you.

## PREPARED STATEMENT OF DR. LYNN R. SYKES

### INTRODUCTION AND CONCLUSIONS

Chairman Byron, members of the committee I address you today as a scientist who has been involved in the detection and identification of the testing of nuclear weapons for the past 24 years. I am the Higgins Professor of Geological Sciences at Columbia University. I was a member of the U.S. delegation that negotiated the Threshold Test Ban Treaty with the Soviet Union in 1974. I have been a member of several U.S. Government panels that have examined questions of verification of atomic testing. I am presently a member of a scientific panel for the Department of Defense that examines methodology for estimating the yields of Soviet explosions. I am member of the U.S. National Academy of Sciences and the American Academy of Arts and Sciences. Seismology, my main field of expertise, provides the main tools for verification of a Comprehensive Test Ban Treaty, for ascertaining if the Soviet Union has complied with the 150 kiloton limit set by the Threshold Test Ban Treaty and for making accurate estimates of the sizes of Soviet atomic tests and of weapons emplaced on Soviet strategic systems.

Let me first give you a statement of the major points I wish to make in my testimony:

1. A Comprehensive Test Ban Treaty (CTBT) is verifiable with high confidence down to explosions of very small size. The lower limit of reliable identification can be reduced to about 1 kiloton with a combination of seismic listening posts within the U.S.S.R. and other national technical means such as satellite photography. Recent advances in seismology ensure that attempts

to detonate clandestine explosions under a CTBT will be even easier to detect than was thought only a few years ago.

2. An alternative to a Comprehensive Treaty is a Low-Yield Threshold Test Ban Treaty with a threshold limitation of about one or a few kilotons. A Low-Yield Threshold Treaty or a CTBT would drastically curtail the testing and development of a so-called third generation of new atomic weapons.
3. There is now near scientific unanimity on the methodology of correctly estimating the sizes or yields of Soviet explosions. When this methodology is employed, it is evident that the Soviet Union has not violated the 150 kiloton limit of the Threshold Test Ban Treaty. Both the U.S.S.R. and the United States have tested repeatedly near that limit since the treaty entered into force in 1976.
4. It is in our national interest that the Soviet Union not test very large nuclear weapons and thence emplace more lighter-weight weapons on their large intercontinental missiles. The Threshold Treaty and Salt II have constrained the number of intercontinental missiles deployed by the U.S.S.R. and the sizes of the nuclear weapons carried by those systems. In the absence of such restraints, the U.S.S.R. would probably have an asymmetrical advantage in that it could conduct very large underground tests easier than the United States and deploy weapons of either greater yield or greater numbers on their large ICBMs.
5. Both the Threshold Test Ban Treaty (TTBT) and the Peaceful Nuclear Explosions Treaty (PNET) can be verified with high confidence. U.S. ratification of both of those treaties would con-

strain the U.S.S.R. by treaty from conducting large nuclear weapons tests.

6. Seismic data now provide accurate estimates of the sizes of large Soviet weapons tests that were conducted in the ten years prior to the Threshold Treaty. The sizes of those tests can be used to estimate the yields of nuclear weapons that were emplaced on Soviet strategic systems in the late 1970's. Those yields are lower than many other published estimates. Hence, the total megatonnage of U.S.S.R. strategic systems does not appear to be much larger than that for U.S. systems as has often been claimed.
7. The main impediments to a Comprehensive Treaty or a Low-Yield Threshold Treaty are neither scientific nor technical but rest on the notion that the security of the United States is best enhanced by continued testing and development of new atomic weapons.

## VERIFICATION OF A COMPREHENSIVE NUCLEAR TEST BAN TREATY

Active interest in a Comprehensive Test Ban Treaty (CTBT) is now more than 30 years old. A CTBT, which still does not exist today, is one of the longest running issues on the arms control agenda. The Nuclear Freeze proposal and the Summit meeting have heightened public and congressional interest in taking steps to avoid nuclear war. A ban on atomic testing has been a major component of various freeze proposals.

The field of seismology provides the main tools for the detection of underground atomic testing, for the identification of signals from an event as being those of either an underground test or those of an earthquake. Most seismologists who have been involved in test ban research, like myself, conclude that the main technical and scientific impediments to verifying a CTBT were solved between 1963 and 1970. Since that time the capabilty to detect small explosions and to identify or discriminate their signals from those of small earthquakes has steadily improved. The United States has conducted an extensive program to improve the detection of nuclear tests for 26 years. We have spent about a half billion dollars in this endeavor; more than a billion dollars has been spent worldwide. Seismic methods for identifying nuclear testing improved greatly during that period as a result not only of funds spent specifically for that purpose but also as a result of the more than three to four billion dollars that is spent annually by the petroleum and mineral industries and by various government agencies on the acquisition of seismic data and on improved seismic methods. Seismology has grown from a small, relatively weak field in the late 1950's to one that now provides considerable knowledge in the search for new energy and mineral resources and in the development of better methods and instruments for verifying a Comprehensive Test Ban Treaty.

Extensive negotiations towards a Comprehensive Treaty were conducted among the United States, the United Kingdom and the Soviet Union from 1977 to 1980. All of the long-contested aspects of verifying such a treaty were resolved, at least in principal, by 1980 including a moratorium on the testing of peaceful explosions, provisions for U.S. seismic monitoring posts within the U.S.S.R., international exchange of seismological data, and on-site inspections of the challenge type. Those negotiations have been in recess since 1980.

The announced policy of the United States Government has long been to enter a Comprehensive Test Ban Treaty provided it could be adequately verified. A halt to the testing of all nuclear weapons was the original goal of the negotiations that led to the Limited Test Ban Treaty of 1963.

In July 1982 the New York Times and other newspapers carried the story that the United States Government had decided not to continue test-ban negotiations with the U.S.S.R. and the United Kingdom. Three reasons were cited for the decision: 1) a lack of adequate seismic methods for verifying a comprehensive treaty; 2) an assertion that the Soviet Union either had or may have cheated repeatedly on the Threshold Treaty by denotating explosions above its 150 kiloton limit; and 3) the security of the United States is best enhanced by the rapid development and testing of new atomic weapons.

## Continued Nuclear Testing

Figure I* shows the yearly number of nuclear tests conducted by the six countries that denotated atomic weapons between 1945 and 1982. The Limited Test Ban Treaty (LTBT) of 1963 had a positive effect in that the U.S., the U.S.S.R. and U.K. (all of which signed the treaty) did not test in the atmosphere after 1963. The LTBT put an end to the testing of very large weapons, i.e., those of tens of megatons. It clearly did not put an end to nuclear testing itself, which merely went underground after 1963. The LTBT had another negative effect in that public interest in test bans diminished greatly after 1963. Tests in the atmosphere, with attendant fallout and mushroom-shaped clouds, were a much less abstract phenomenon to most of the public than tests underground.

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*Charts and tables appear in oral statement.

The number of weapons tests from 1963 to 1985 greatly exceeds the number of tests prior to 1963. About 10 to 20 percent of the tests conducted by the U.S.S.R. since 1974 have been peaceful nuclear explosions (PNE's). The United States has not conducted peaceful explosions since 1973. It is evident from Figure 1 that the United States and the Soviet Union have conducted by far the greatest numbers of tests.

Figure 2 shows the sizes of nuclear weapons that have been tested thus far. By examining the yields of U.S. and U.S.S.R. underground tests from 1963 to 1985, we find that both countries denotated a comparable number of tests of intermediate yield (20 to 200 kilotons) and a similar number of larger tests. The largest underground test to date was the Cannikin explosion of a yield of about 5000 kilotons conducted by the U.S. in the Aleutians Islands in 1971. In the attached preprint of a paper by Sykes and Wiggins we estimated the sizes of the largest Soviet underground tests for the time period before the Threshold Treaty entered into force in 1976. A careful calibration by different methods indicates that the largest Soviet underground explosion had a yield of about 3500 kilotons, somewhat smaller than that of the largest U.S. underground test.

Figure 2 shows the great range in the yields of atomic weapons that have been tested thus far. One kiloton (kt) is equivalent in energy release to that of 1000 tons of TNT. The sizes of weapons that opened the Atomic Age in 1945 were about 12 to 22 kt. With the advent of the hydrogen bomb in the 1950's, weapons of much larger yield were tested. The largest weapon test thus far was the 58,000 kt Soviet explosion of 1961 in the atmosphere at their Arctic test site.

Some measure of the size of nuclear weapons can be realized from the fact that 5000 kt, the approximate size of the largest underground explosion to date, is somewhat greater in explosive power than all of the munitions expended in World War II. Announced yields of weapons carried by intercontinental ballistic missiles are in the range 40 to 9000 kt. Both the U.S.S.R. and the U.S. have deployed about 18,000 strategic weapons of that size range. While the TTBT put an end to the testing of larger weapons in that range, it did not limit the testing of all weapons carried by intercontinental missiles.

## Verification of a Comprehensive Test Ban Treaty by Seismic Methods

The main problem in seismic verification of a CTBT has been to distinguish the signals of small explosions from those of the many small earthquakes that occur around the world every year. The location of a seismic event, its depth below the surface of the earth, and pronounced differences in the frequency content of signals from underground explosions and earthquakes provide powerful methods for identifying a given signal as being either that of an earthquake or underground test. These methods are described in more detail in the attached paper from Scientific American of October 1982 by Sykes and Evernden and in my testimony of May 8, 1985 before the Subcommittee on Arms Control, International Security and Science of the House Committee on Foreign Affairs.

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Seismological methods will always have some lower limit of detection or of identification, regardless of the seismic network used for surveillance. Our work and that of many others indicates that signals from underground explosions and earthquakes can be distinguished with very high reliability down to a certain lower limit. That lower limit depends critically upon whether a treaty on atomic testing would allow U.S. seismic stations in the Soviet Union and on what attempts might be made to hide illegal tests. Results for these various possibilities are given in Table 1.

When the trilateral test ban talks were recessed in 1980 the U.S.S.R. had agreed to allow U.S. seismic listening posts on its territory and the United States had agreed to allow Soviet stations on our territory. Line 1 of Table 1 indicates that a good external seismic network has the capability of verifying underground testing with yields of 1 kiloton or larger for well-coupled explosions, i.e., the case in which no attempt is made to muffle, disguise or hide the seismic waves generated by an underground test. That limit drops below 0.1 kilotons if stations internal to the U.S.S.R. are added to the external network.

Several different evasion or cheating possibilities have been discussed extensively for many years. They include detonation of explosions in low-coupling materials (the most extreme possibility being explosions detonated in dry, porous alluvium, i.e., dry gravel and sand), detonation of explosions in very large underground cavities, timing underground explosions to occur soon after large earthquakes such that their signals would be hidden or masked, and setting off several explosions with small time delays so as to make certain waves look more earthquakelike.

The detonation of underground explosions in a low-coupling material has been discussed for many years. The intent here would be to produce very small seismic waves for an explosion of a given size. Many misleading statements have been made about this possible method of clandestine testing. It is very important to remember that while it may work for the U.S.S.R., it is limited to explosions of very small size. For example, the thicknesses of dry, porous alluvium in the U.S.S.R. do not permit contained tests in that medium larger than 1 to 2 kilotons. That sets the limit for the external network in line 2 of Table 1. Augmenting the external network with stations internal to the U.S.S.R. reduces that cheating possibility to 1 kiloton or smaller. The use of that evasion scheme, even at very low yields, is very risky since dry, porous alluvium is easily disturbed. Any signficant surface disturbance would be observed easily with satellite photography.

Most of those specialists who have worked on the verification of a CTBT are in agreement that the denotation of explosions in very large cavities represents the most significant evasion possibility. It sets the overall limit on the size of explosions that might not be positively identified as such under a CTBT if the U.S.S.R. were to make its best attempts to cheat on the treaty. That scenario is mentioned extensively in the various testimony presented to your committee on September 18, 1985.

I think that Big Hole evasion has been seriously overrated for a number of reasons. The volume of rock that must be excavated to fully decouple an explosion of about 8 kilotons is approximately equivalent to the volume of the largest Egyptian pyramid, a fact that pessimists about a CTBT usually forget to mention. Most of the work in the United States and the United Kingdom on this topic is now 20 to 30 years old. U.S. and British experiments of 25 years ago with conventional explosives indicated that the decoupling idea does work for explosions of a few tons. The U.S. detonated one underground explosion named STERLING in a salt dome in Mississippi to test the decoupling theory. At that time it was the policy of the U.S. Government to emphasize verification by methods that could be used at intercontinental distances, i.e., with stations external to the U.S.S.R. That assumption as well as data from the Nevada Test Site suggested at the time that seismic waves would not be observable for frequencies higher than 1 to 2 Hz, i.e., 1 to 2 cycles per second.

Figure 3 indicates that a muffling ratio of 200 was predicted theoretically at those frequencies. The observed ratio was about 60 at those frequencies. The data collected from the experiment as well as theoretical calculations indicate that the amount of muffling is much less at higher frequencies, i.e., 15 to 30 Hz. Thus, if we could obtain a high-frequency monitoring capability for much of the Soviet Union, cheating possibilities using large underground cavities would be much more severely limited.

In the last few years it has been recognized that high-frequency seismic waves propagate readily across large parts of the Soviet Union. This represents an important advance in our capability to verify a CTBT. Several of those who testified on September 18 including the Director of the Lawrence Livermore Laboratory and Dr. Ralph Alewine of the Defense Advanced Research Projects Agency, emphasized the potential promise (my italics) of high-frequency signal detection. I believe that reality lies somewhere between the technique being merely one of potential but unproven promise and one that has been fully perfected.

A great deal of seismic data has been obtained in Europe and Asia, including large parts of the U.S.S.R., for seismological studies of the crust of the earth and for exploration for petroleum and minerals. Those data are very good for frequencies from 1 to about 10 Hz. In addition, high-frequency data have been analyzed from several of the seismic arrays operated by the United Kingdom and from several of the sophisticated stations operated by the U.S. Department of Energy as a test of instruments that could be deployed in the U.S.S.R. under a test ban treaty. Those data generally indicate propagation of high-frequency waves with good signal-to-noise ratios from small explosions in continental areas of older geology. A high percentage of the U.S.S.R. consists of older geological areas.

Extensive data have now been collected by the Norwegian seismic array (NORSAR) from explosions in several parts of the U.S.S.R. Figures 4 and 5 illustrate the sizes of seismic waves as a function of frequency for two small explosions north of the Caspian Sea at the Azgir test site and two at the test site in Central Asia in eastern Kazakhstan. The two underground explosions at Azgir have yields of about 10 to 20 kilotons while the two explosions from Central Asia have yields of approximately 1/2 and 1 to 2 kilotons respectively. Note that all except the smallest event have signal levels that are larger than the noise levels for signal levels as high as 20 Hz. The upper seismogram of Figure 6 indicates the processed output from the Norwegian array from a small event with a yield of about 1 to 2 kilotons at Azgir. It can be seen that the signal is much much larger than the noise proceeding it. In their Semi-Annual Technical Summary the Norwegians indicate the sizes of events on the seismic $m_b$ magnitude scale that could still be well detected in the presence of noise. The lower trace of Figure 6 shows that a signal can still be readily detected from an event as small as magnitude $m_b$=2.15.

Table 2, which is taken from a recent Semi-Annual Technical Summary by the Norwegians indicates that their array alone has detection thresholds of magnitude 2.0 to 2.5 for the western one quarter of the total area of the U.S.S.R. In his testimony of September 18, Dr. Alewine estimates that "if the verification objective is to detect all nuclear tests as small as one kiloton or more, it now appears that a detection threshold of about magnitude 2.5 is required." I believe that Dr. Alewine's number is too pessimistic and that a more reasonable estimate is about $m_b$ 2.8 to 3.2 for various parts of the U.S.S.R. Nevertheless, it is clear that high-frequency seismic waves and the use other national techical means can reduce the possibilities of clandestine testing to explosions of a very small size.

It should be remembered that the Norwegian data were taken along paths that were 1800 and 2600 miles from the Azgir and Central Asian test sites respectively. U.S. seismic listening posts within the U.S.S.R. as agreed to in the negotiations from 1977 to 1980, if they are equipped for a high-frequency capability, would allow greater areas of the Soviet Union to be monitored and at closer distances. Undoubtedly, there will be some areas of the U.S.S.R., particularly in the vicinity of Lake Baikal and along the southern borders of the U.S.S.R., for which it is likely that high-frequency seismic waves do not propagate efficiently. Evasion opportunities could be reduced by placing more U.S. seismic monitoring posts in those areas and by making sure that external stations are available near the southern borders of the U.S.S.R.

Another possible method of evasion that has been discussed extensively is the so-called Hide-in-Earthquake scenario. The idea here is to detonate a small explosion soon after a large earthquake such that its signals will be masked or covered by those of the larger earthquake. This scenario has a major disadvantage in that nuclear weapons must be kept in readiness in a totally clandestine manner for long periods of time awaiting an earthquake of sufficient size. A very sophisticated seismic network would be needed to tell immediately that the earthquake was in fact of large enough size. Hence, the opportunities for using this method of evasion are limited to small explosions.

Figure 7 shows another use of high-frequency seismic monitoring, in this case for detecting small explosions detonated at or near the time of large earthquakes. The upper seismogram shows a conventional recording with low frequencies. It and the lower figure show the arrival of waves from a large earthquake in the eastern part of the U.S.S.R. at a time of 30 seconds. The lower recording is of higher frequency waves. It shows a very large high-frequency arrival soon after a time of 100 seconds. That second event, which is not very evident on the upper trace, was an explosion of about 1/2 a kiloton from the Central Asian test site of the U.S.S.R. While it must be assumed that some allowance must be made for the possibility of hiding signals in those of earthquakes, the great differences in the excitation of high-frequency seismic waves from small explosions and moderate to large earthquakes indicates that the application of that cheating possibility is very limited. Similarly, the detonation of a series of nuclear explosions might confuse any one seismic method of discrimination but not the many that are available.

Several of those persons who testified on September 18 mentioned that the U.S.S.R. might be able to detonate much larger explosions clandestinely behind the Sun. That scheme has also been mentioned for more than 25 years. I think, as do many others, that it belongs in the category of a wild fantasy. Quite evidently the U.S. Government did not give credence to that scheme in its decision to enter test ban negotiations in 1977. For a test behind the Sun to be of use to the U.S.S.R., it would be necessary for an instrument package to collect a great amount of data and to relay it back to the Earth. The United States conducts extensive monitoring of signals from Soviet spacecraft. If there remains any doubt that testing behind the Sun is any more than a fantasy, the United States could deploy additional satellites for monitoring such a possibility or insist as part of a test ban treaty that data not be encrypted for space probes that pass behind the Sun.

## Unidentified Seismic Events and Other Problems of Verification

No monitoring technology can offer an absolute assurance that even the smallest illicit explosion would be detected. It has been asserted that, for the United States to subscribe to a CTBT, a 90% confidence of detecting and identifying each and every violation would be required. Most of our calculations have been done for that level of confidence. Developing new atomic weapons, however, generally requires a series of tests. The probability that at least one underground explosion in a series would be detected rises sharply as the number of tests increases.

It should be recognized that there will be an asymmetry under a CTBT in terms of the probability of detection a potential violator would regard as worth risking versus say a 90% capability that the U.S. would want to have. For example, it seems very unlikely that the U.S.S.R. would decide to conduct a clandestine test if the United States had say an 80% or 90% chance of identifying it. Thus, a capability to detect and identify an event with 90% confidence would probably provide a considerable deterent against the U.S.S.R. conducting tests of somewhat smaller size than that associated with a 90% level of confidence.

Dr. W. J. Hannon of the Lawrence Livermore Laboratory published what appears to be a pessimistic assessment of seismic methods of verification in the January 18, 1985 issue of Science. In our Scientific American article of October 1982, Evernden and I conclude that verification can be accomplished with high reliabilty down to explosions of about 1 kiloton in size even given the most strenuous attempts to evade identification. That assessment assumes that the United States obtains a number of listening posts in the U.S.S.R. under a test ban treaty. It is important to realize that both articles agree on several important points. Both recognize that seismic arrays are highly effective for the detection of signals of small events in the presence of earth noise. Each study reports extensive computer calculations of the detection capabilities of various networks designed to monitor the U.S.S.R. The two articles report nearly identical capabilities for cases in which nearly identical seismic networks are assumed.

Five points in the Hannon paper (which is referred to extensively by Dr. Batzel in his testimony of September 18) are responsible for his more pessimistic estimates: 1) it is assumed that explosions will be detonated at times of high seismic noise, 2) cavity decoupling is taken as a serious possibility not only in salt but also in hard rock in many parts of the U.S.S.R., 3) satellite photography is not assumed to play a major role in monitoring a CTBT, 4) a high-frequency seismic monitoring capability is not used in the calculations and 5) it is assumed that a large percentage of events that are detected will not be positively identified as being earthquakes.

The experience in operating the Norwegian seismic array and other seismic stations is that temporal variations in noise level do occur but only at very low frequencies, those less than 2 Hz. Thus, even the very modest capability to record waves with frequencies up to 5 Hz guarantees that temporal variations in earth noise will not be a problem.

While it is certainly possible to construct an underground cavity sufficient to decouple say 0.1 kilotons, the construction of larger cavities in any rock other than salt would surely be easily detected on satellite photography. Remember that hugh volumes of rock must be excavated to decouple explosions of 1 to 10 kilotons. At a decoupling symposium organized by the U.S. Department of Energy last summer speakers pointed out how extremely difficult it would be to construct a cavity in hard rock sufficient to fully decouple 10 kilotons. The expense of constructing just a single cavity of that size would be enormous even if it could be done. Thus, the only way in which it would be possible to conduct a clandestine explosion in a large cavity would be to construct it by solution mining in a very thick, uniform sequence of salt. The areal extent of appropriate salt deposits is much more limited in the U.S.S.R. than areas of hard rock. Thus, a seismic monitoring capability to very low magnitudes such as the figure of $m_b$=2.5 that Dr. Alewine indicated on September 18 does not need to be obtained for the entire territory of the U.S.S.R. but only for those areas of thick, uniform sequences of salt such as major salt domes or thick bedded salt.

In my estimation the most serious problem confronting the United States under a Comprehensive Treaty would be how to deal with the problem of unidentified events and how to reduce their number to near zero. Surprisingly, very little thought has been given to this question in the United States. Thinking in the United States tends to be more geared to having routine assessments made by technicians using computer analysis and algorithms and with little further analysis of a few special events by experts. While that approach can be useful for categorizing large numbers of seismic events as earthquakes, greater care needs to be given to the handling of the small number of events per year that will not be identified so easily. Hannon apparently has not allowed for a second step of expert analysis as I advocate.

In 1972 the United States Government submitted a report to the UN's Conference on the Committee on Disarmament describing a number of events in Asia that appeared to be earthquakes but which could not be clearly distinguished as having their signals different from those of explosions. Three of us studied that suite of so-called anomalous or problem events. Upon re-analysis we found that a large body of data in the public domain had not even been used to categorize them. By substantially increasing the observations, many of events ceased to be problematic and were positively identified as earthquakes. By applying other seismic discriminants we were able to show that every problem event on that list was in fact an earthquake.

Recent work on the statistics of the recording of small seismic events indicates that unless a correct analysis procedure is used small events that are near the detection limits of a network will have their magnitudes overestimated. When a correction is made for this effect it is clear that the number of events worldwide (or in the U.S.S.R.) of say magnitude $m_b$ 4.0 is much smaller than had long been thought. Thus, the number of events of a certain size or larger that must be surveyed in monitoring a CTBT is substantially smaller than had been thought until a few years ago.

Some of the testimony of September 18 before this committee emphasized the problem of large chemical explosions under a CTBT. Many chemical explosions, especially those used for blasting rock, are often set off in a delayed sequence such that their signals do not resemble those of an impulsive underground test. Nevertheless, other industrial explosions are detonated nearly instantaneously and do constitute a monitoring problem. Very few chemical explosions have explosive yields in excess of 0.1 kilotons and only a very few in excess of 1 kiloton. Those below 0.1 kilotons only become a problem if it is assumed that the muffling ratio for underground tests in large cavities is in excess of a factor of ten, ie., that no high-frequency monitoring capability exists. An item that should be negotiated in arriving at a Comprehensive Test Ban Treaty would be a provision for prior announcement and for some type of surveillance, perhaps on-site inspection, for chemical explosions of yields larger than say about 0.1 kilotons.

## MILITARY SIGNIFICANCE OF TEST OF VARIOUS YIELDS AND THE ALTERNATIVE OF A LOW-YIELD THRESHOLD TREATY TO A CTBT

An as yet unresolved aspect of monitoring of a CTBT is the required magnitude or yield threshold of the monitoring network. Many discussions speak in terms of 1 kiloton as if there is some kind of tacit if not implicit agreement that this is indeed the agreed-upon magic number. In conjunction with testimony before the House Armed Services Committee in 1978 Dr. Harold Agnew, a former Director of Los Alamos, replied in a letter "I don't believe testing below say five to ten kilotons can do much to improve (as compared to maintaining) strategic posture." As regards both strategic and theatre significance, he said "The military significance to either the U.S.S.R. or the U.S.A. of conducting clandestine tests below five to ten kilotons is per se of relatively little importance today."

In a recent article "Militarily Significant Nuclear Explosive Yields" R. E. Kidder of the Lawrence Livermore Laboratory plotted a histogram of the number of recent U.S. explosions as a function of yield. That diagram is reproduced in Figure 8. It can be seen that there are major peaks in the frequency of U.S. tests with yields of about 12 and 150 kilotons. Soviet tests for the same period show a very similar distribution. Kidder states that only 5% of our tests were of yields less than 1 kiloton and 18% were of yields less than 5 kilotons.

If we assume, following Kidder, that the number of tests performed near a given yield constitutes a measure of the military significance of that yield, at least in the eyes of those responsible for the testing program, then Figure 8 may be regarded as a graph of perceived military significance versus yield. Thus, for that time interval the military significance of tests below 1 kiloton was perceived to be very low, those below 5 kilotons relatively low and those near 12 and 150 kilotons were regarded as high.

It has been argued that a full test ban would give the U.S.S.R. an asymmetrical advantage in that they might conduct clandestine tests of very small yield whereas the United States would not. An alternative to a CTBT would be a Low-Yield Threshold Treaty with the limit set by the capabilities for reliable verification. Table 1 indicates that with external monitoring alone it would be possible to monitor a Low-Yield Threshold Treaty for explosions of about 10 kilotons and larger. Such a limitation, however, would be at or very close to the major peak in testing for the U.S. and the U.S.S.R. of about 7 to 20 kilotons. To eliminate arguments about the precise yields of explosions it would seem more advisable to have the limitation of a Low-Yield Treaty on one side or the other of that major peak.

U.S. stations within the U.S.S.R. and the employment of other means of surveillance provide an opportunity for reliable monitoring down to levels of about 1 kiloton. About two years ago scientists from universities, one of the weapons laboratories and the Department of Defense discussed verification capabilities of a network internal to the Soviet Union for the monitoring of a low-yield treaty; each arrived at somewhat different numbers but all of them were in the range 1 to 5 kilotons. A threshold limitation of 1 to 5 kilotons would eliminate about 82 to 95% of the testing that has been conducted by the U.S.S.R. and the U.S. of the past five years.

A Low-Yield Threshold Treaty would not give the U.S.S.R. a possible asymmetrical advantage. Also, it would permit the weapons laboratories of the two countries to continue testing but at low yields.

## SOVIET COMPLIANCE WITH THE THRESHOLD TEST BAN TREATY

The Threshold Test Ban Treaty (TTBT) was signed by President Nixon in Moscow in 1974 and entered into force in 1976. For various reasons that treaty, like Salt II, has not been ratified by the United States Senate. Over the past few years various officials of the United States Government have stated that the Soviet Union is likely to have violated the Threshold Treaty by testing above its 150 kiloton limit.

Last spring the Subcommittee on Arms Control, International Security and Science of the House Committee on Foreign Affairs heard testimony about Soviet compliance with the TTBT in conjunction with House Joint Resolution 3. I and a number of other seismologists familiar with the estimation of yields of Soviet explosions by seismic methods have long argued that the U.S. Government uses an incorrect method of seismic calibration that overestimates the sizes of Soviet explosions. A great deal of new scientific work on this subject using many different techniques has been completed during the last year. The results of those seismological studies all indicate that the current methodology based on short-period compressional (P) waves contains a systematic calibration error that results in overestimates of yields of Soviet underground weapons tests at their Central Asian test site. The largest Soviet explosions since the TTBT entered into force in 1976 have taken place at that test site. The calibration error essentially arises from a failure to account for differences in the absorption of those seismic waves that pass beneath various test sites. Most, but not all, of our data come from Nevada, a region of young geology and greater seismic absorption whereas the main U.S.S.R. test sites are all situated in regions of old geology that are less absorbing.

Yields of explosions at the Central Asian test site of the U.S.S.R. have now been calibrated using: 1) seismic surface waves that are unaffected by the above effect, 2) a high-frequency seismic surface wave called Lg, 3) a Soviet peaceful explosion at that test site that produced a crater of known size (for which the Soviets have also released the yield), 4) estimates of the seismic attenuation beneath the Central Asian and Nevada test sites using the fall-off of the spectrum of seismic waves, 5) a calibration using seismic stations on areas known to be similar geophysically to the Central Asian test site, and 6) more indirect estimates based on the known speed of seismic waves and other known geophysical parameters of the Central Asian and other test sites. In addition, it is now possible to remove from surface waves a contaminating effect called tectonic release such that surface waves can now be used for accurate estimates of yield.

Each of the above methods indicates that the Central Asian test site can be calibrated in terms of yield quite accurately. The Defense Advanced Research Projects Agency and the Air Force Technical Applications Center have had committees of seismologists advise them on these matters for many years. Panels of both agencies have submitted classified reports on yield estimations for Soviet explosions and have made specific recommendations on methodology and calibrations.

There is now near scientific unanimity on the correct methodology for estimating yields of Soviet explosions and of uncertainties in yield estimates. If these methodologies are employed, it is evident that the U.S.S.R., like the U.S., has tested repeatedly close to the 150 kiloton limit of the TTBT since 1976 but has not tested significantly above it. Reasonable differences of opinion still revolve about uncertainties of 10 to 15% in the average yield of the 12 or so largest explosions that the U.S.S.R. has detonated since the TTBT entered into force. There is no scientific basis from seismology, however, for allegations that have been made that the U.S.S.R. has tested in excess of 150 kilotons by factors of 2, 4 or 6 times that amount. It is my understanding that a panel of the Defense Intelligence Agency has recently reviewed various methods of estimating yields of Soviet explosions and has completed a classified report on that subject.

I find it interesting that in the various testimony given on September 18 the question of Soviet cheating on the Threshold Treaty is played down or not mentioned by several of those who have been involved deeply in this matter. The main exception is the testimony given by Dr. Richard Wagner in which he states "Therefore, each side has an obligation under international law to observe the 150-kiloton (sic) threshold. The United States has done so; it is likely that the Soviet Union has not." He goes on to say that large uncertainties in our estimates have prevented us from determining conclusively whether the Soviet Union is, in fact, violating the 150 kiloton limit. Those statements neither reflect the great deal of scientific work and synthesis that have been been accomplished in the last year nor do they represent the views about correct methods for estimating yields and uncertainties in yields as reflected currently by scientific experts.

## ALLEGED VIOLATIONS BY U.S.S.R. OF ARMS CONTROL AGREEMENTS

The President's Unclassified Report to the Congress on Soviet Non-Compliance with Arms Control Agreements, which was released on February 1, 1985, states that the U.S.S.R. either has violated or probably has violated 11 major provisions of various arms control agreements. It states that the U.S.S.R. is likely to have violated the nuclear testing limit of the Threshold Test Ban Treaty and has violated the Limited Test Ban Treaty (LTBT) of 1963. Thus, alleged violations of two test ban treaties constitute an important component of the President's report.

The LTBT specifically prohibits nuclear explosions in the atmosphere, in outer space and underwater. It is clear that neither the U.S.S.R., the United States nor any of the other 123 countries that signed and ratified the LTBT have violated the principal prohibition on tests in the atmosphere, outer space or underwater.

A second clause of the LTBT prohibits nuclear explosions in any other environment (such as underground) "if such explosion causes radioactive debris to be present outside the territorial limits of the State under whose jurisdiction or control such explosion is conducted." It is that second aspect of the LTBT that the U.S. indicates the Soviet Union has violated. In return, the U.S.S.R. has accused the United States of violating the LTBT, the TTBT and number of other arms control agreements.

In the document of February 1, 1985 the President's report finds "The U.S. Government judges that the Soviet Union's underground nuclear test practices have resulted in the venting of radioactive matter and caused radioactive matter to be present outside the Soviet Union's territorial limits in violation of its legal obligation to the Limited Test Ban Treaty. The Soviet Union has failed to take the precautions necessary to minimize the contamination of man's environment by radioactive substances despite U.S. request for corrective action."

Both the U.S.S.R. and the U.S. have detonated many tests for which radioactive material has vented at the surface. In several instances radioactive material has been detected outside of the borders of either country. Both the United States and the U.S.S.R. have been aware of this for many years but have only recently made the other's actions on this aspect of the LTBT a part of a broad list of accusations.

Thus, in the two areas in which I have expertise — the verification of the LTBT and TTBT -- scientific evidence indicates that both the U.S. and the U.S.S.R. have clearly been in violation of a secondary clause of the LTBT and the U.S.S.R. has not violated the TTBT.

Adding those treaties to a long list of allegations tends to dilute emphasis on aspects of much greater importance such as either the Soviet radar at Krasnoyarsk or the provision of Salt II that prohibits more than one new type of ICBM.

## DISADVANTAGES TO UNITED STATES SECURITY BY NOT RESTRAINING SOVIET TESTING

Relatively little attention has been focused on the disadvantages that are likely to follow if the 150 kiloton limit on the testing of nuclear weapons is not continued. Both the United States and the Soviet Union have had to conduct their very largest underground tests at very remote sites away from their main testing areas in Nevada and Central Asia, respectively. Prior to the TTBT the U.S. conducted its largest tests at Amchitka in the Aleutian Islands while the U.S.S.R. conducted its largest tests at its Arctic test site at Novaya Zemlya.

The U.S.S.R. has continued to conduct some small tests at their Arctic test site in conformance with the terms of the TTBT. The United States, however, tested at Nevada after 1976 but not at Amchitka. The United States could not conduct very large tests in Nevada without incurring damage in Las Vegas and possibly in Reno. Thus, in the absence of an agreement between the U.S. and U.S.S.R. not to conduct very large tests, the U.S.S.R. could resume the testing of weapons larger than one megaton relatively easily while the United States could not do so very quickly or easily.

The TTBT and PNET also provide a means for the U.S. to maintain its technological lead in strategic systems. My estimates indicate that weapons that were tested by the U.S.S.R. in the period just before the TTBT went into effect in 1976 and were placed on Soviet strategic systems in the following few years have lower yield-to-weight ratios, i.e., they are heavier, than those on comparable American systems. Thus, it is certainly not in the best interests of the United States to have the Soviet Union conduct weapons' testing to full yield of lighter-weight weapons of say 500, 1,000, or 2,000 kilotons. They have not conducted tests of those sizes since 1975. Ratifying the Threshold Treaty would restrain them by treaty from doing so again.

## SIZES OF WEAPONS ON SOVIET STRATEGIC SYSTEMS

In examining Soviet compliance with the Threshold Treaty we discovered that U.S.S.R. testing practice since the treaty took effect in 1976 is to detonate many weapons of a few specific sizes. Sykes and Wiggins (see appendix) re-examined the yields of the largest weapons tested by the U.S.S.R. from the start of underground testing by the U.S.S.R. in 1962 until the TTBT entered into force in 1976. The period 1970 to 1976 is crucial since nuclear weapons probably were being tested at that time for subsequent deployment on various versions of the SS-17, 18 and 19, especially on those models or mods equipped with multiple warheads.

Figure 2 from that appendix shows that large nuclear weapons tested from 1962 to 1976 at the Arctic test site of the Soviet Union at Novaya Zemlya are clustered into a few specific yields, of which 500 kilotons is the dominant peak. We obtained consistent results from two quite different types of seismic techniques. The U.S.S.R. seems to place considerable emphasis on the repeated testing of weapons of a few specific yields. Obviously both the United States and U.S.S.R. realized when they signed the TTBT in 1974 that they had only 21 months to complete the testing of either new large-yield weapons or those in their stockpiles with yields well above the 150 kiloton limit of the TTBT. In those 21 months the U.S.S.R. conducted at least 3 tests of 500 kilotons and none at any of their test sites with yields between 75 and 500 kilotons. Five-hundred kilotons is obviously a very important yield for one or more Soviet weapons.

MIRVed versions of the Soviet SS-17, 18 and 19a became operational in the late 1970's, soon after those large tests were conducted at Novaya Zemlya. Our estimates of 500 kilotons for the sizes of the weapons that were emplaced on those systems in the late 1970's are among the lowest that have been published or given in congressional testimony. For example, Paul Nitze in his congressional testimony of July 12, 1979 gives the yields of the weapons on those three systems as 750 kilotons. We also estimated that by the expiration of the Salt II treaty in 1985 the U.S.S.R. would have three times the megatonnage of the United States.

The MIRVed versions of the above three Soviet systems, however, account for a large percentage of the total megatons of U.S.S.R. strategic capability. Hence, correct estimates of the yields of those weapons have a considerable impact on calculations of the lethality of U.S.S.R. nuclear weapons and of the total megatonnage of Soviet strategic systems. Nitze's yields are a factor of 1.5 too large for those three weapons systems. A number of other sources give yields that are even larger and hence portray the U.S.S.R. as having more powerful weapons than the United States. My estimates of the total megatonnage carried by Soviet systems indicates that it is only slightly greater than that of U.S. strategic systems. While accuracy is much more important in judging the lethality of weapons used against hard targets like missile silos, nevertheless, total megatonnage has important pyschological consequences for questions like Is the U.S.S.R. ahead of the United States or we do we need to build and test more nuclear weapons?. It is clear that along with overestimates of the sizes of Soviet tests since the TTBT entered into force, that other estimates of the megatons emplaced on Soviet strategic systems must also be reduced considerably.

## CONCLUSIONS

In summary I have argued that a Comprehensive Test Ban Treaty can be verified with high reliability down to explosions of very small size even given the best attempts on the part of the Soviet Union to test clandestinely. By employing U.S. seismic listening posts within the Soviet Union and using other surveillance methods such as satellite photography, it should be possible to monitor a test ban with high reliability down to explosions of about 1 kiloton. An alternative to a CBTB would be a Low-Yield Threshold Treaty with a threshold of one to a few kilotons. Of U.S. or U.S.S.R. tests conducted from 1980 through 1984 only about 5% were of yields smaller than 1 kiloton. While verification is obviously of great importance to the United States and we must make a major and determined effort in verification if we are to sign a test ban treaty, the major question facing us in this area as a nation is whether our national security is best enhanced by a program of rapid development and testing of new atomic weapons or by strenuous attempts to reach bilateral, verifible and equitable arms control agreements of substance with the Soviet Union. We need to make sure that correct scientific methodology is used in estimating not only the sizes of Soviet tests since the Threshold Treaty entered into force but also the yields of weapons that are likely to be emplaced on Soviet strategic systems. In both of those areas there has been a considerably tendency to overestimate the sizes of Soviet tests and the yields of deployed Soviet nuclear weapons.

Geophysics

# YIELDS OF SOVIET UNDERGROUND NUCLEAR EXPLOSIONS AT NOVAYA ZEMLYA, 1964-1976, FROM SEISMIC BODY AND SURFACE WAVES

(arms control/verification of test ban treaties/nuclear weapons/
seismic magnitudes)

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## ABSTRACT

Surface and body wave magnitudes are determined for 15 U.S.S.R. underground nuclear weapons tests conducted at Novaya Zemlya between 1964 and 1976 and are used to estimate yields. These events include the largest underground explosions detonated by the Soviet Union. A histogram of $m_b$ values indicates a clustering of explosions at a few specific yields. The most pronounced cluster consists of 6 explosions of yield near 500 kt. Several of these seem to be tests of warheads for major strategic systems that became operational in the late 1970's. The largest Soviet underground explosion is estimated to have a yield of 3500 ± 600 kt, somewhat smaller than the yield of the largest U.S. underground test. A preliminary estimation of the significance of tectonic release is made by measuring the amplitude of Love waves. The bias in $m_b$ for Novaya Zemlya relative to the Nevada test site is about 0.35, nearly identical to that of the eastern Kazakhstan test site relative to Nevada.

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Abbreviations: kt, kiloton(s); LQ, Love wave amplitude; LR, Rayleigh wave amplitude; $m_b$, body wave magnitude(s); $M_s$, surface wave magnitude(s); NTS, Nevada test site; TTBT, Threshold Test Ban Treaty; Y, yield.

The Soviet Union conducted their largest underground nuclear weapons tests at two Arctic sites in Novaya Zemlya between the signing of the Limited Test Ban Treaty in 1963 and March 31, 1976, when the Threshold Test Ban Treaty (TTBT) entered into force. The TTBT prohibits the testing of nuclear weapons by the U.S. and U.S.S.R. of yields in excess of 150 kilotons (kt). Since 1976 the majority of U.S.S.R. tests, including all of the largest, were conducted in eastern Kazakhstan. Sykes and Cifuentes (1) and others argue that the yields of the largest explosions at that site since 1976 were close to 150 kt, the limit of the TTBT.

Since yields have not been released for Soviet nuclear weapons tests, seismic methods must be used to estimate their yield. This study uses seismic surface wave magnitudes ($M_s$) and body wave magnitudes ($m_b$) to calculate yields of explosions at Novaya Zemlya. Particular emphasis is placed on using accurate calibration curves for $M_s$ and $m_b$ that give results that are consistent with one another. Emphasis is given to achieving accuracy in yield estimation at the 30 to 50% level for individual explosions and higher accuracy for the mean yield of groups of explosions that appear to be of nearly identical yield so that inferences can be made about the sizes of weapons in the Soviet strategic arsenal.

Since the attenuation of seismic P waves varies greatly beneath various test sites, the amplitudes of P waves at observation points (and the derived magnitude $m_b$) cannot be used without correcting for systematic biases between sites. Surface wave amplitudes (and the magnitude $M_s$ estimated from them), however, exhibit much less regional variation and therefore provide a better (less biased) estimation of yield than do uncalibrated $m_b$ data. Der et al. (2) estimated biases in $m_b$ between various test sites by examining the differential attenuation of short-period P waves. They find that attenuation beneath either of the two test sites at Novaya Zemlya is nearly identical to that for Amchitka Island, Alaska, where the largest U.S. underground tests were conducted, and for eastern Kazakhstan, but is much less than that beneath the Nevada test site (NTS). Thus, yields of Novaya Zemlya (or eastern Kazakhstan) explosions calculated from $m_b$ using uncorrected relationships for Nevada should be too large by a factor of about 2.5 to 3.7 for explosions of 100 to 5000 kt.

We estimated yields for Novaya Zemlya in two ways: from an $m_b$-yield regression curve using data from Nevada and Amchitka after correcting $m_b$ by 0.35 and .027 units respectively and from surface waves using the $M_s$-yield calibration curve of (1). Those $m_b$ corrections were obtained by (2) from attenuation studies. Most yields estimated by these two methods are in close agreement.

## MATERIALS AND METHODS

The yields of the 15 largest U.S.S.R. explosions ($m_b \geq 5.9$) at the southern and northern Novaya Zemlya test sites between 1963 and 1976 were estimated using $m_b$ and $M_s$. The larger events were well recorded on analog records of the World-Wide Standardized Seismograph Network. For events smaller than $m_b$ 5.9, 20 s surface waves were difficult to distinguish against the background noise. Rayleigh wave amplitudes (LR) with periods from 18 to 24 s were measured on vertical-component records from stations with continental propagation paths from Novaya Zemlya. Love wave amplitudes (LQ) were measured from transverse components. $M_s$ was computed from LR by applying the period and distance corrections of (3).

An underground explosion can trigger the release of natural stress near the shot point by a phenomenon known as tectonic release. The explosion alone cannot produce Love waves, so their presence is evidence of such release. Rayleigh waves are generated by both the explosion itself and tectonic release. The average value of LQ/LR was determined for each event and is taken as a measure of the relative importance of tectonic release compared to that of the explosion itself. Eight events with LQ/LR less than 0.75 are herein described as having relatively low tectonic release. These events do not, however, appear to be systematically different from the rest in the relationship between $M_s$ and $m_b$.

In the determination of $m_b$ and $M_s$, individual stations may report values of those magnitudes that are consistently higher (or lower) than the average for many explosions at a given testing area. The standard error of the mean (SEM) for $m_b$ or $M_s$ can be reduced and the relative accuracy of those quantities from one explosion to another can be increased through the application of station corrections such that the sum of the corrections over all stations and events is zero. Station corrections for $m_b$ were determined for those stations reporting 3 or more explosions. Data from stations with a large uncertainty in their station corrections were omitted.

Station corrections for $M_s$ were derived for stations where $M_s$ could be determined for three or more large ($m_b \geq 6.4$) explosions. For the smallest explosions surface waves were generally registered only at those sensitive stations that reported higher than average $M_s$ values for the larger events. Thus, the smallest explosions were not included in the derivation of station corrections for $M_s$. These corrections were then applied in calculating the average $M_s$ and its SEM for each of the 15 explosions studied. Data were insufficient to generate separate $M_s$ corrections for the southern test site. Differences in surface wave propagation to a given station are likely to be small since the two test sites are about 300 km apart and most of the propagation paths are an order of magnitude longer.

## RESULTS

Bias in $m_b$ between test sites. $M_s$ is plotted as a function of $m_b$ in Fig. 1 for each of the 15 Novaya Zemlya explosions studied. Similar data for explosions detonated either in hard rock or below the water table in Nevada and Amchitka from (4) are also shown. Least-squares regression lines were fit to the data sets for the three regions and are also shown.

The Novaya Zemlya data exhibit a systematically different relationship between $M_s$ and $m_b$ than do those for Nevada, a result of the large difference in P wave attenuation between the test sites. When the regression line for Nevada is shifted by 0.35 $m_b$ units, the bias determined from the differential attenuation of P waves (2), it agrees closely with the Novaya Zemlya data. Thus, observations of $M_s$ confirm that the $m_b$ bias between the test sites is about 0.35 ±.05. A nearly identical correction must be made to calculate yields correctly for eastern Kazakhstan using NTS data. The Amchitka regression line, either corrected for the small $m_b$ bias of .027 (2) or uncorrected as shown in Fig. 1, also fits the Novaya Zemlya data quite well. The slope of the Novaya Zemlya regression line is nearly identical to that for Nevada. The slope of the Amchitka line is not well determined since only three nuclear explosions were detonated at that test site.

Estimates of Yield. Station corrected $m_b$ and $M_s$ determinations and yield estimates are listed in Table 1. $Y_{MS}$ is the yield (Y) calculated from $M_s$ using $M_s = 2.16 + 0.97 \log Y$, a least-squares fit derived (1) using data (4) from underground explosions of known yield either in hard rock or below the water table. $Y_{mb}$ is the yield determined from $m_b$ data for Novaya Zemlya using a regression curve derived for the 11 largest underground explosions of announced yield at NTS and 3 at Amchitka that were detonated either below the water table or in hard rock. NTS and Amchitka $m_b$ values were corrected by 0.35 and .027 $m_b$ units (2) respectively to give $m_b$ = 4.9206 + 0.5597 log Y. In Table 1 we calculated an average yield and its SEM from $Y_{MS}$ and $Y_{mb}$. The SEM is thus a measure of the consistency of the two individual estimates.

While the exact yield of the largest Amchitka test (Cannikin) has not been released, it has been described as less than 5000 kt (4). We calculated a yield of 4400 kt for Cannikin from its $M_s$ of 5.69 (4) using the above relationship between $M_s$ and log Y.

Histogram of Sizes of Underground Explosions. Since $m_b$ can usually be determined for a given event with a smaller SEM than that associated with $M_s$, $m_b$ gives a better estimate of the relative sizes of explosions at a given test site. The mean $m_b$ and SEM for each explosion at Novaya Zemlya from 1963 to 1976 were used to generate the smoothly varying histogram of Fig. 2. It shows a particularly prominent cluster of events near $m_b$ 6.43. When several events at one small testing area combine to produce such a pronounced peak in the histogram, it can be assumed that the explosions making up that peak have nearly identical yields, the geological coupling between explosion size and seismic wave amplitude is nearly identical and the burial depths of the explosions are similar (depth affects the combined waveform of the direct P and surface reflected pP waves).

## DISCUSSION

The clustering of $m_b$'s about a few specific values in Fig. 2 has several important implications. The peaks near 130, 500 and 2000 kt (and perhaps near 1000 kt) probably correspond to multiple tests of weapons of nearly identical yield. We are impressed how close many of the calculated yields are to the round numbers 500, 1000 and 2000 kt. The pattern in Fig. 2 as well as the repeated testing of weapons at eastern Kazakhstan of yields near 75 and 150 kt indicates that the U.S.S.R. seems to place considerable emphasis on the repeated testing of weapons of a few specific yields.

Fig. 3 shows the two estimates of yield for each explosion at Novaya Zemlya as a function of date from the start of underground testing at the northern test site in 1964 through 1976. It indicates a greater frequency of testing from 1973 through 1975. The large number of tests near 500 kt, especially in the interval between the signing of the TTBT and the date it entered into force, as well as the high yield of the main peak in Fig. 2 strongly suggest the testing of one or more weapons at full yield. Obviously, both the United States and the U.S.S.R. realized when they signed the TTBT in July 1974 that they had only 21 months to complete the testing of either new large-yield weapons or those in their stockpiles with yields well above the 150 kt limit of the TTBT. The Soviet SS-17 Mod 3, SS-18 Mod 4 and SS-19 Mod 3---all MIRVed ICMB's---became operational about 1979; earlier Mods, a few years earlier. The MIRVed versions of these three systems accounted for about 64% of the total megatons of U.S.S.R. weapons that could be carried intercontinental distances in mid-1982 (5). Thus, correct determinations of the yields of weapons on those 3 systems have a great impact on estimates of the lethality of U.S.S.R. nuclear weapons and of their total megatonnage. Ref. 6 estimates yields of the individual weapons of the three ICBMs as 750, 500 and 550 kt respectively. Many other sources give higher yields. From the histogram in Fig. 2, 500 kt seems appropriate for all three systems.

Ref. 5 estimates the yield of multiple warheads deployed on the Soviet SS-N-6, SS-N-18 and SS-11 missiles as 200 kt. Fig. 2 and Table 1 indicate, however, that no devices have been tested at Novaya Zemlya with yields between about 130 and 400 kt (perhaps even 130 to 500 kt). Our calculations and those of Ref. (1) indicate that the yields of the largest weapons tested at eastern Kazakhstan from 1964 to 1983 are about 150 kt. Thus, there is no indication from seismic data that the U.S.S.R. has tested any weapons underground at any of their test sites with yields between about 150 and 400 kt. The fact that the U.S.S.R. tested several 500 kt weapons in the interval between the signing of the TTBT in 1974 and its entry into force in 1976 (Fig. 3) and none of 50 to 500 kt casts doubt on the reality of a 200 kt weapon.

The yields calculated from either $m_b$ or $M_s$ (Table 1) for individual explosions do not differ from one another by more than a factor of 1.83 and most are within a factor of 1.5. Similarly, individual estimates do not differ from the average yields by more than a factor of 1.4. We expect that averages made over two techniques (Table 1) for a given test and those made using data from several explosions (i.e., those constituting peaks in Fig. 2) are more accurate than individual estimates of yield.

The greatest difference in yield estimates was for the explosion of Oct. 18, 1975, which is described as particularly anomalous when its waveforms are compared with those of other explosions (7). Burger et al. (7) suggest two explosions of nearly equal size were detonated simultaneously about 21 km apart. If this is correct, the number of 500 kt tests should be increased by two and only one event with a yield of about 1000 kt remains. The event of Aug. 28, 1972, whose $m_b$ value appears as a side lobe on the major peak in Fig. 2, has a yield of 480 kt as calculated from $M_s$. It is questionable if its average yield differs significantly from 500 kt. It is possible that the yields of the tests of 1966 and 1972 may, in fact, have been closer to 400 kt.

The effects of tectonic release have not been taken into account fully in our yield estimations. Many events show significant tectonic release (Table 1). The smaller events at Novaya Zemlya plotted in Fig. 1 are not necessarily of high tectonic release but rather are indeterminate because the the signal-to-noise ratio for Love waves is small. Focal mechanisms for tectonic release indicate nearly pure strike-slip faulting at southern Novaya Zemlya (7). This mechanism should have little if any effect on $M_s$ if measurements are averaged over a 180° range of azimuths. Although the azimuthal distribution of stations is not uniform, the data cover azimuths from 90° to 270°. Hence, the effect of tectonic release on $M_s$ determinations for events at the southern test site is expected to be very small.

A focal mechanism for tectonic release at the northern test site involves nearly equal components of strike-slip and normal faulting (7). In this case the existence of tectonic release should lead to an $M_s$ value as average over 180° that is somewhat higher than that for the explosion itself. Thus, yields derived from $M_s$ for the northern test site may be biased slightly high for explosions of large LQ/LR. There is no indication of this effect, however, in comparing explosions of low and high LQ/LR in Fig. 1. The separation of 0.33 $m_b$ units between the regression curves for Novaya Zemlya and NTS explosions in Fig. 1 cannot be attributed to tectonic release and is reasonably attributed to bias in $m_b$.

In using an $M_s$-yield calibration curve that was derived largely from tests in North America (1), we assume that seismic attenuation for LR as averaged over propagation paths in Eurasia is identical to that as averaged over paths in North America. Differences in average surface wave attenuation, coupling at the source, azimuthal coverage and tectonic release probably become important at the .05 to .10 level for $M_s$ (and hence at the 15 to 25% level for yields). The assumption that $m_b$ as obtained as an average for the network that we used can be compared directly with the $m_b$ of explosions at NTS and Amchitka (after correction for bias) as determined by a slightly different world-wide network also probably breaks down at the 15% level. Probably the greatest uncertainty in the present use of $m_b$ arises from not taking into account differences in the interference of the direct P wave and the surface reflected pP phase. Thus, the use of full waveforms in data analysis could provide more accurate estimates of yield.

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## FIGURE CAPTIONS

Fig. 1. Surface wave magnitude $M_s$ as a function of body wave magnitude $m_b$ for underground explosions at Novaya Zemlya, Nevada and Amchitka (Aleutian Islands). Nevada and Amchitka data are from (4). Least-square regression lines are fit to data sets for three testing areas. Lines through data points denote one SD.

Fig. 2. Gaussian histogram of number of Novaya Zemlya explosions as a function of $m_b$. A Gaussian function of the appropriate SEM and mean $m_b$ and with unit area under the function (insert) was calculated for each event. The individual functions were summed over all explosions to produce the smoothly varying histogram. Stated yields are averages of estimates made from $M_s$ and $m_b$.

Fig. 3. Yields derived from $m_b$ and $M_s$ as a function of date for Novaya Zemlya explosions. Vertical lines denote one SD. Position along time axis for some points is shifted slightly for clarity in plotting.

Table 1. Parameters of underground nuclear explosions at Novaya Zemlya

| Date | Test* Site | $m_b$ | $n_b$[†] | $M_s$ | $n_s$[#] | $Y_{MS}$ (kt) | $Y_{mb}$ (kt) | Average Yield (kt) | LQ/LR |
|---|---|---|---|---|---|---|---|---|---|
| Oct. 27, 1966 | N | 6.39±.034 | 23 | 4.70±.108 | 5 | 420 | 420 | 420±4 | .83 |
| Oct. 21, 1967 | N | 5.92±.056 | 12 | 3.99±.090 | 5 | 77 | 61 | 69±8 | |
| Nov. 7, 1968 | N | 6.02±.025 | 27 | 4.30±.076 | 6 | 160 | 92 | 126±35 | |
| Oct. 14, 1959 | N | 6.09±.019 | 28 | 4.27±.057 | 6 | 150 | 120 | 140±14 | .76 |
| Oct. 14, 1970 | N | 6.60±.025 | 33 | 5.02±.066 | 7 | 890 | 1000 | 940±60 | 84 |
| Sept. 27, 1971 | N | 6.47±.023 | 25 | 5.06±.038 | 8 | 980 | 590 | 780±200 | .51 |
| Aug. 28, 1972 | N | 6.33±.021 | 28 | 4.76±.037 | 8 | 480 | 330 | 400±70 | .70 |
| Sept. 12, 1973 | N | 6.78±.031 | 26 | 5.26±.046 | 9 | 1570 | 2100 | 1830±260 | .63 |
| Sept. 27, 1973 | S | 5.95±.034 | 7 | 3.74±.102 | 3 | 43 | 69 | 56±13 | |
| Oct. 27, 1973 | S | 6.94±.018 | 13 | 5.51±.052 | 6 | 2840 | 4050 | 3450±610 | .63 |
| Aug. 29, 1974 | N | 6.43±.021 | 26 | 4.88±.027 | 10 | 640 | 500 | 570±70 | .42 |
| Nov. 2, 1974 | S | 6.78±.020 | 13 | 5.29±.040 | 5 | 1690 | 2100 | 1890±210 | .60 |
| Aug. 23, 1975 | N | 6.42±.024 | 29 | 4.72±.049 | 8 | 440 | 480 | 460±20 | .71 |
| Oct. 18, 1975 | S | 6.66±.028 | 11 | 4.92±.065 | 6 | 700 | 1280 | 990±290 | .81 |
| Oct. 21, 1975 | N | 6.43±.028 | 22 | 4.78±.030 | 10 | 500 | 500 | 500±3 | .45 |

*N denotes northern test site; S, southern.

[†] Number of P readings used for $m_b$ determination.

[#] Number of surface wave observations used for $M_s$ determination.

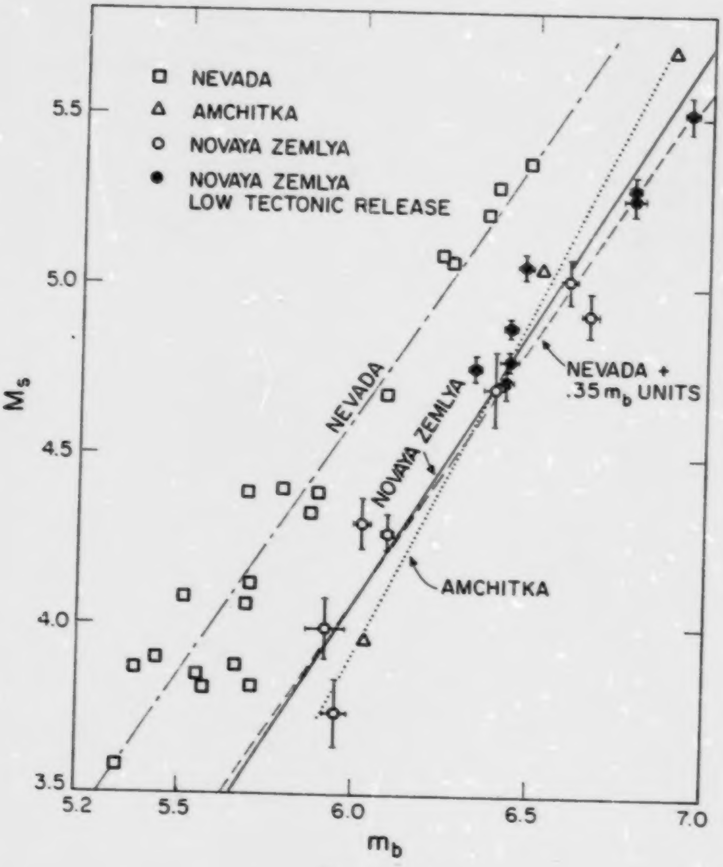

Figure 1

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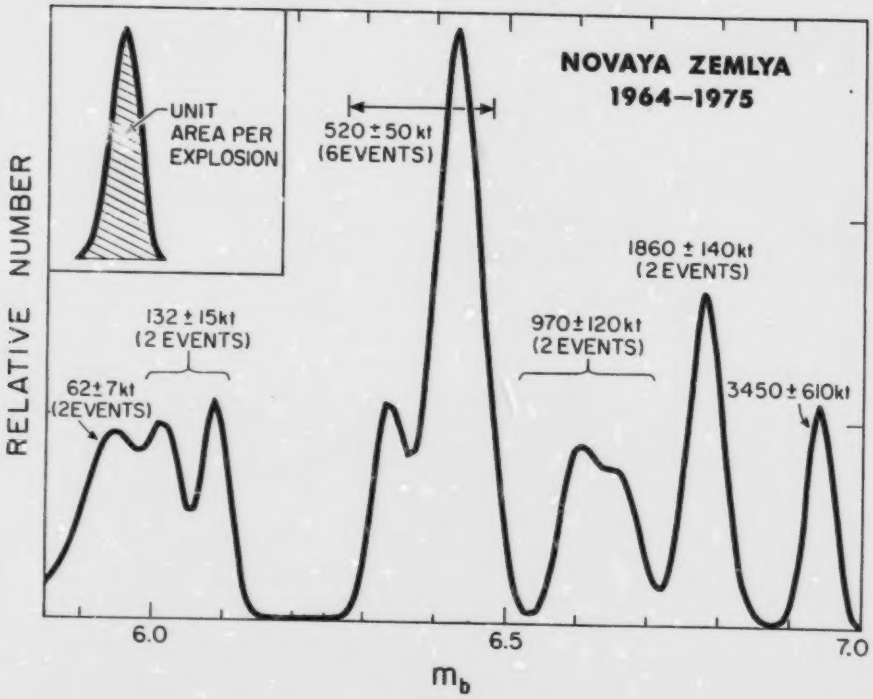
NOVAYA ZEMLYA
1964–1975
UNIT AREA PER EXPLOSION
RELATIVE NUMBER
62 ± 7 kt (2 EVENTS)
132 ± 15 kt (2 EVENTS)
520 ± 50 kt (6 EVENTS)
970 ± 120 kt (2 EVENTS)
1860 ± 140 kt (2 EVENTS)
3450 ± 610 kt
6.0
6.5
7.0
$m_b$

Figure 2

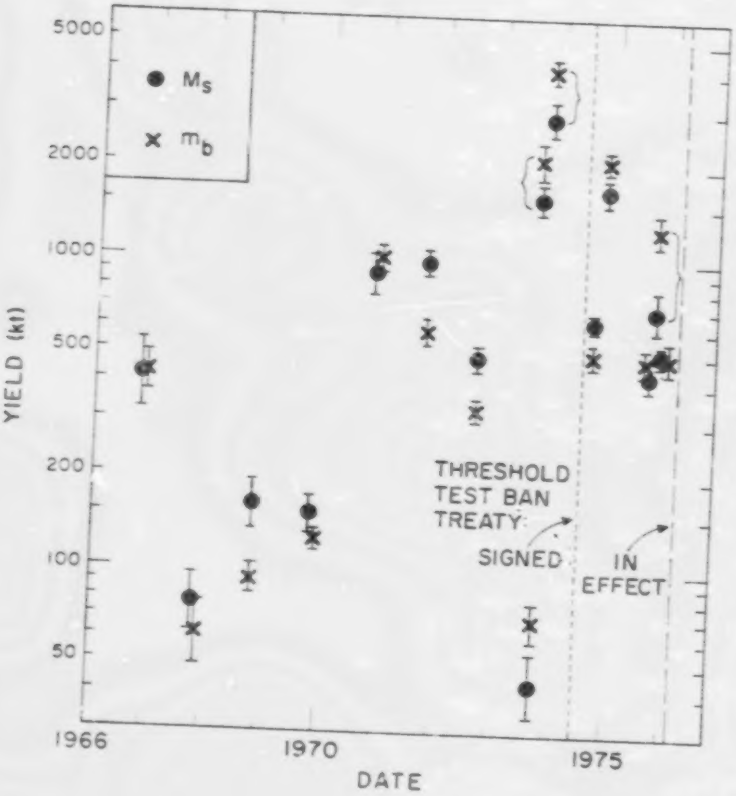
5000
2000
1000
500
200
100
50
YIELD (kt)
$M_s$
$m_b$
THRESHOLD
TEST BAN
TREATY:
SIGNED
IN
EFFECT
1966
1970
1975
DATE

Figure 3

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# The Verification of a Comprehensive Nuclear Test Ban

by Lynn R. Sykes and Jack F. Evernden

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# The Verification of a Comprehensive Nuclear Test Ban

*Networks of seismic instruments could monitor a total test ban with high reliability. Even small clandestine explosions could be identified even if extreme measures were taken to evade detection*

by Lynn R. Sykes and Jack F. Evernden

Two treaties put into effect over the past 20 years have set limits on the testing of nuclear weapons. The Limited Test Ban Treaty of 1963, which has been signed by more than 120 nations, prohibits nuclear explosions in the atmosphere, the oceans and space, allowing them only underground. The Threshold Test Ban Treaty of 1976, a bilateral agreement between the U.S. and the U.S.S.R., prohibits underground tests of nuclear weapons with a yield greater than 150 kilotons. In the present climate of widespread pressure for more effective control of nuclear arms the idea of a comprehensive ban on all nuclear testing is receiving renewed attention. Such an agreement would be an important measure. It might inhibit the development of new weapons by the major nuclear powers, and it might also help to prevent the spread of nuclear-weapons technology to other countries.

A halt to all testing was the original goal of the negotiations that led to the 1963 Limited Test Ban. New talks with the aim of achieving a total ban were begun in 1977 by the U.S., the U.S.S.R. and Britain, but the talks were suspended in 1980. In both cases the main impediment to a comprehensive treaty was the contention by the U.S. and Britain that compliance with the treaty could not be verified because sufficiently small underground nuclear explosions could not be reliably detected and identified. In July the Reagan Administration announced that the test-ban negotiations with the U.S.S.R. and Britain will not be resumed. Once again the primary reason given was a lack of confidence in methods of verifying compliance.

In 1963 the reliability of measures for the verification of a treaty banning explosions larger than about one kiloton may have been arguable, but it no longer is. We address this question as seismologists who have been concerned for many years with the detection of underground explosions by seismic methods and with means of distinguishing underground explosions from earthquakes. We are certain that the state of knowledge of seismology and the techniques for monitoring seismic waves are sufficient to ensure that a feasible seismic network could soon detect a clandestine underground testing program involving explosions as small as one kiloton. In short, the technical capabilities needed to police a comprehensive test ban down to explosions of very small size unquestionably exist; the issues to be resolved are political.

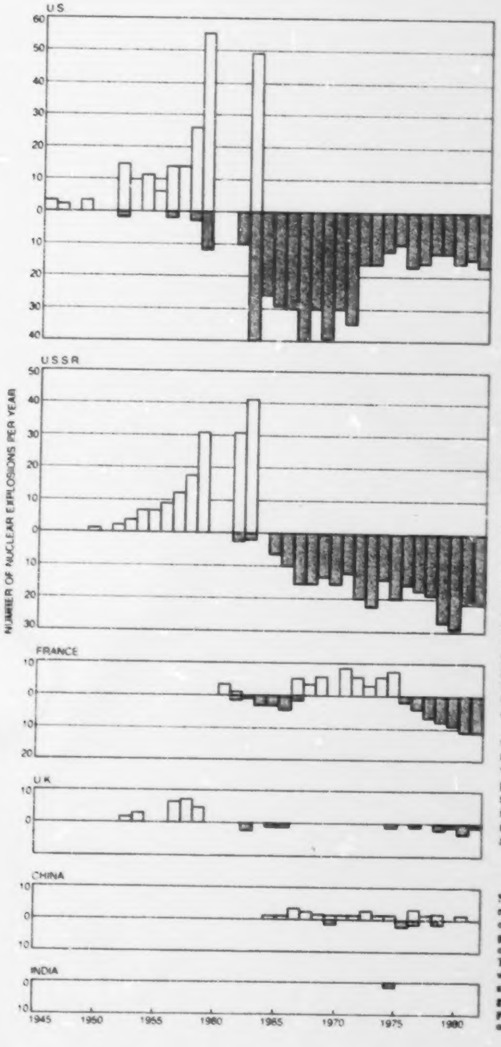
An underground explosion sets up elastic vibrations that propagate as seismic waves through the earth and along its surface. The waves travel great distances, and seismic monitoring instruments in common use are sensitive enough to record even those generated by very small explosions. Once the waves have been detected the main task is to distinguish the seismic signals of explosions from those of earthquakes. This can be done with a network of several widely separated seismometers.

Two types of elastic vibrations can propagate through the solid body of the earth, that is, through the crust and the mantle. The first waves to arrive at a seismometer are compressional waves, which are similar to sound waves in air or water; the seismological name for them is *P* (for primary) waves. The slower body vibrations are shear waves, which are similar to the waves on a vibrating string; they are called *S* (for shear or secondary) waves. An underground explosion is a source of nearly pure *P* waves because it applies a uniform pressure to the walls of the cavity it creates. An earthquake, on the other hand, is generated when two blocks of the earth's crust rapidly slide past each other along the plane of a fault. Because of this shearing motion an earthquake radiates predominantly *S* waves.

A result of the spherical symmetry of the explosion source is that all the seismic waves it generates have a nearly radial symmetry around the focus of the explosion. In contrast, the highly directional character of an earthquake source gives rise to seismic waves with strongly asymmetric patterns. The asymmetry in the amplitude of the waves received at seismometers throughout the world provides the means whereby seismologists can determine the faulting mechanism of a given earthquake.

In addition to the *P* and *S* body waves there are also two types of seismic waves that propagate only over the surface of the earth. They are called Rayleigh waves and Love waves, and they result from complex reflections of part of the body-wave energy in the upper layers of the earth's crust. A simple explosion can generate Rayleigh waves but not Love waves, whereas an earthquake generates waves of both types.

Seismologists characterize the size of a seismic event by means of magnitudes. A given event can be assigned several



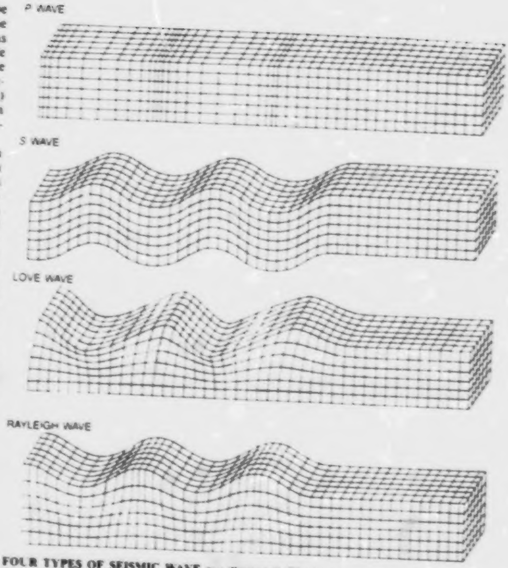
magnitudes, each one based on a different kind of seismic wave. A magnitude is the logarithm of the amplitude of a particular type of wave normalized for distance and depth of focus. Of the numerous magnitudes that can be defined for a single seismic event we shall discuss only two, which in seismological notation are designated $M_S$ and $m_b$. The former is generally based on Rayleigh waves with a period of 20 seconds, the latter on one-second *P* waves. The magnitude of a seismic signal is ultimately related to the energy released at the site of the event. For a nuclear explosion the customary measure of energy release is the yield in kilotons, where one kiloton is the energy released by detonating 1,000 tons of TNT.

Every year there are numerous earthquakes whose magnitudes are in the range corresponding to the yields of underground explosions. Several methods can be applied to several types of waves to distinguish the seismic waves of explosions from those of earthquakes. The location of a seismic event and its depth below the surface are important criteria; indeed, the great majority of routinely detected events can be classified as earthquakes simply because they are either too deep or not at a plausible site for an explosion. The remaining events can be reliably classified by the amount of energy radiated in the several kinds of waves at various frequencies.

The location of an event in latitude and longitude is a powerful tool for classification. The position is determined by recording the arrival time of short-period *P* waves at several seismographic stations in various parts of the world. The travel time of the *P* waves to each station is a function of distance and depth of focus. From the arrival times it is possible to determine the location of the source with an absolute error of less than 10 to 25 kilometers if the seismic data are of high quality.

The identification of seismic events at sea is quite simple. It is assumed that the network monitoring a test-ban treaty would include a small number of simple hydroacoustic stations around the shores of the oceans and on a few critical islands to measure pressure waves in seawater. The hydroacoustic signal of an underwater explosion is so different

**NUCLEAR TESTS CONTINUE** to be carried out at a rate of about 50 per year, principally by the two leading nuclear-weapons powers: the U.S. and the U.S.S.R. As this bar chart shows, the main effect of the Limited Test Ban Treaty of 1963 (*broken vertical line*) was not to reduce the number of test explosions but merely to drive most of them underground. Nuclear test explosions in the atmosphere and underwater are represented by colored bars, those underground by gray bars.



**FOUR TYPES OF SEISMIC WAVE** are illustrated. The two waves at the top propagate through the solid body of the earth; the two at the bottom propagate only near the surface. The compressional body waves called *P* (for primary) waves travel fastest and are the first ones to arrive at a seismometer; they are the predominant type of body wave produced by an underground explosion. The slower body waves called *S* (for shear or secondary) waves vibrate in a plane transverse to their direction of propagation; they are the predominant type of body wave produced by an earthquake. The surface waves called Rayleigh waves and Love waves result from complex reflections of the *P* and *S* body waves in the upper layers of the earth's crust.

from that of an earthquake and can be detected at such long range that the identification of a seismic event at sea as an explosion or an earthquake is simple and positive. Hence any event whose calculated position is at least 25 kilometers at sea (a margin allowing for errors) can be classified as an earthquake on the basis of its location and the character of its hydroacoustic signal.

The accuracy with which the position of a seismic event can be determined in an area offshore of an island arc has been tested with an array of ocean-bottom seismometers off the Kamchatka Peninsula and the Kurile Islands in the U.S.S.R. The tests indicate that the accuracy of a seismic network under these circumstances is much better than 25 kilometers. Holding to that standard, however, one finds that well over half of the world's seismic events are definitely at sea and are therefore easily identified as earthquakes.

Another large group of detected events have their epicenters on land but in regions where no nuclear explosions are to be expected; these events too can be safely classified as earthquakes. Indeed, almost all the world's seismic activity is in regions that are of no concern for monitoring compliance with a comprehensive test ban. Thus the simple act of locating seismic events classifies most of them as earthquakes.

Calculating the depth of focus provides a means of identifying a large fraction of the remaining earthquakes. From 55 to 60 percent of the world's earthquakes are at depths of more than 30 kilometers, at least 90 percent are more than 10 kilometers deep. Any seismic event as deep as 15 kilometers is certainly an earthquake. No one has yet drilled into the earth's crust as far down as 10 kilometers, and the deepest nuclear explosions have been at a depth of about two kilometers.

Several seismological procedures can be employed to determine an event's depth of focus. In most cases the depth is calculated at the same time as the location. When a seismic event is detected at 20 stations or more, a routinely calculated depth of 30 kilometers or more ensures with a 95 percent degree of confidence that the event was at least 15 kilometers below the surface.

A powerful technique for estimating depth can be applied if at least one seismological station is within a few hundred kilometers of the detected event. (A monitoring network for a comprehensive test ban would be quite likely to meet this condition in areas where nuclear testing might be expected.) A pair of *P* and *S* waves generated at the same instant and recorded by a station near the event follow identical paths but propagate at different speeds. The difference in their times of arrival, or in other words the difference in their phases, therefore serves to determine the time of origin of the event. With experience the seismograms of a station near the event can be successfully analyzed to detect at least one pair of such *P* and *S* phases. Given the time of origin determined in this way and the arrival times of the *P* waves at only a few distant receivers, an accurate estimate of the depth of focus can be made.

There may remain critical seismic regions where nearby stations do not exist. Data from large events can then be employed to refine the calculated depth and location of smaller events. The essence of the technique is to correct the observed times of small events by noting the differences between the observed and the calculated times for a large event in the same area. The procedure is in routine use by several networks.

The combined effectiveness of location and depth in distinguishing earthquakes from explosions is impressive. More than 90 percent of all earthquakes either are under oceans or are at least 30 kilometers deep (or both). Most of the remaining earthquakes are of little interest because they are in countries that are unlikely to be testing nuclear weapons or in countries where clandestine testing would be impossible. For the U.S., of course, the U.S.S.R. is the country of prime interest. About 75 percent of the earthquakes in and near the U.S.S.R. are in the eastern part of the country near the Kamchatka Peninsula and the Kurile Islands. Almost all of the shocks in these areas either have a focal depth greater than 50 kilometers or are well offshore. It turns out that seismic events whose calculated position is on land in the U.S.S.R. or less than 25 kilometers at sea and whose calculated depth is less than 50 kilometers constitute only about 5 percent of the world's earthquakes. This amounts to about 100 earthquakes per year with an $m_b$ magnitude greater than 3.8 for which other seismic discriminants must be employed.

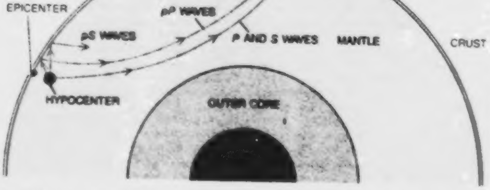
None of the measures we have discussed so far relies on the detailed characteristics of the waves radiated by earthquakes and explosions. Several powerful discriminants are based on those characteristics, in particular on the relative amounts of energy in waves of different types and periods. For example, a shallow earthquake generates 20-second Rayleigh waves with amplitudes at least several times greater than those of an explosion that releases the same amount of energy. In the notational practice of seismology the comparison of the two magnitudes is referred to as the $M_S : m_b$ ratio, that is, the ratio of long-period to short-period waves.

A second spectral discriminant is based on the observation that long-period *P* and *S* waves are rarely or never seen in association with explosions but one type or the other is routinely detected today by simple seismometers for most earthquakes that have a one-second *P*-wave magnitude of at least 4.5. More sophisticated seismic stations and more sophisticated analysis of the signals could lower the magnitude at which such waves can be detected.

A third distinction is that surface waves of the Love type are generated far more strongly by shallow earthquakes than they are by underground explosions, including even abnormal explosions. Still another characteristic feature of the seismic signal from explosions is that the first motion of the earth stimulated by *P* waves is always upward because the explosion itself is directed outward; the first *P*-wave motion in an earthquake can be either upward or downward.

An important factor contributing to the separation of earthquakes from explosions on an $M_S : m_b$ diagram is that *P* waves from the two kinds of events have different radiation patterns. Explosions radiate short-period *P* waves equally in all directions, whereas earthquakes have very asymmetric patterns. Hence most earthquake sources show a decrease of from .4 to one magnitude unit from the peak values when the *P*-wave amplitudes are averaged over pertinent radiation angles. A simple explosion does not initially radiate any shear waves; earthquakes typically generate large shear waves. As a result Rayleigh waves generated by many types of earthquakes have a larger amplitude than the corresponding waves generated by underground explosions of the same $m_b$.

There is a characteristic time for the formation of the source of a seismic event; the time is equal to the maximum source dimension divided by the velocity of source formation. The source dimension for earthquakes is the length of the break where most of the short-period energy is released; it is from three to 20 times greater, depending on the state of stress in the rocks, than the radius of the cavity and shatter zone of a comparable explosion. The velocity of source formation for earthquakes is from somewhat less to much less than the velocity of shear waves in the rocks surrounding the fault, whereas the relevant velocity for explosions is the velocity of shock waves in the rock, which is essentially the velocity of compressional waves. As a result of these differences in the size of the source and the velocity of source formation the characteristic times for earthquakes and explosions differ by a factor of from six to 40. It is therefore not surprising that differences are observed between the short-period *P*-wave spectra of earthquakes and explosions.



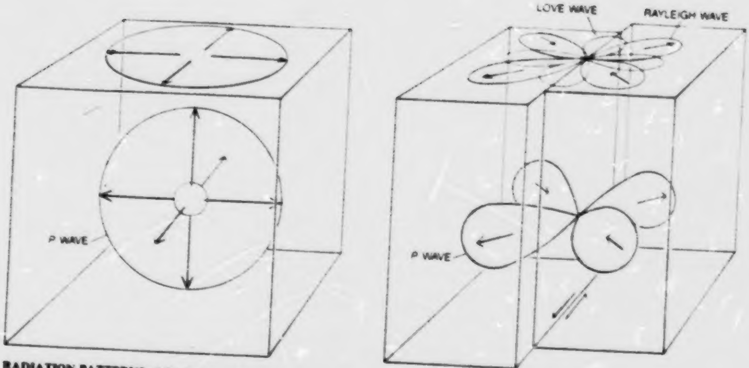
**PATHS OF SEISMIC WAVES** are traced on a cross section of the earth. Body waves from an earthquake or an explosion travel through the crust and mantle along the curved paths labeled *P*, *S*, *pP* and *pS*. A *pP* wave is a compressional wave that is produced by the reflection of a *P* wave from the surface of the earth just above an earthquake or an explosion; a *pS* wave is a shear wave that results from the conversion of part of the compressional energy of an upward *P* wave into transverse energy as the *P* wave is reflected from the surface. Surface waves such as Rayleigh waves and Love waves diminish rapidly in amplitude with increasing depth. The hypocenter is the focal point of an earthquake or an underground explosion from which the waves radiate. The epicenter is the point on the earth's surface directly over the hypocenter.

Observations of several U.S. explosions have demonstrated the existence of a phenomenon called overshoot. It is related to shock waves in strong rock, but it can be thought of as the equivalent of cavity pressure rising to high values followed by a decrease in pressure by a factor of four or five; the lower pressure is then maintained for many tens of seconds. Overshoot, when it occurs, provides additional *P*-wave spectral discrimination and augments discrimination by means of the $M_S : m_b$ ratio for larger events.

It was once thought that an explosion could not give rise to any Love waves at all. A phenomenon that was of great significance in thwarting President Kennedy's effort to achieve a comprehensive test-ban treaty in 1963 was the observation that many underground nuclear explosions at the U.S. testing site in Nevada, particularly those in hard rock, generated unmistakable Love waves. The failure of the qualitative criterion "No Love waves from explosions" (at a time when such quantitative criteria as the comparison of the magnitudes of long-period and short-period waves were not adequately established) left seismologists unable to guarantee their ability to distinguish the seismic waves of underground explosions from those of earthquakes.

The presence of Love waves in the Nevada tests has since been explained. What was not considered in the earlier analyses was the influence of the natural stressed state of the earth on the waves generated by an explosion. The creation of a cavity and its surrounding shatter cone by an underground explosion leads to the release of some of the natural stress, which in turn generates seismic waves equivalent to those of a small earthquake, including Love waves. The observed waves are a superposition of the waves from the explosion and from the release of the stress.

The release of natural stress also alters the amplitude of Rayleigh waves. The perturbation has never been large enough, however, to put in doubt the nature of an event identified by the ratio of long-period to short-period waves. Only rarely does the perturbation significantly affect the amplitude of *P* waves; it is not known ever to have changed the direction of their first motion. Moreover, if the magnitude $M_S$ is determined from Love waves rather than Rayleigh waves, the ratio method ($M_S : m_b$) provides an excellent discriminant.



**RADIATION PATTERNS** of the *P* waves resulting from an underground explosion (*left*) and an earthquake (*right*) are compared. The first motion of the *P* waves from an explosion is uniformly outward and hence is generally observed as an upward displacement at all seismic stations. The first motion of the *P* waves from an earthquake is outward in some directions and inward in others; the pattern of the waves at the surface depends on the orientation of the plane of the earthquake fault. In the comparatively simple case of a vertical strike-slip fault, shown here, the four-lobed radiation pattern observed at the surface for both *P* waves and Rayleigh waves is a simple projection of the three-dimensional *P*-wave configuration emanating from the hypocenter of the earthquake. The radiation pattern of the Love waves emitted by the same source is rotated by 45 degrees with respect to the surface pattern of the *P* waves and the Rayleigh waves.

In short, if seismologists had done their homework thoroughly by 1963, the nations of the world might well have achieved a comprehensive test-ban treaty then. Today the release of natural stresses in the earth is significant only as a perturbing factor that must be taken into account when the yield of an explosion is estimated from Rayleigh waves.

Reports that earthquakes occasionally have $M_S$ $m_b$ values like those of explosions have been cited as a factor that might impede the effective monitoring of a comprehensive test ban. In analyzing a large set of earthquakes in all parts of the world and of underground explosions in the U.S. and the U.S.S.R. we found only one example of this kind of ambiguity. The focus of the event was far from the area in which the seismometer network gave its best results.

In 1972, at a meeting of the UN Committee on Disarmament, the U.S. submitted a list of 25 "anomalous" events that were said to be indicative of a problem in discrimination. In 1976 the 25 events were reanalyzed by one of us (Sykes) and two other seismologists, Robert Tathum and Donald Forsythe. It was established that about half of the events had $M_S$ $m_b$ values that put them clearly in the earthquake population. Most of the original magnitudes had been determined from only one or two stations, and much existing information had not even been consulted. When the records of other available stations were examined, the events ceased to be "anomalous."

For the remaining problem events $M_S$ $m_b$ measurements based on 20-second Rayleigh waves gave values in the range characteristic of explosions. Several of these events were at depths of from 25 to 50 kilometers, where the possibility of nuclear testing can be excluded in any case, but the magnitude ratio nonetheless demanded explanation. It is known from seismological theory that certain types of earthquakes at these depths excite long-period Rayleigh waves poorly. The theory predicts, however, that Love waves and vibrations called higher-mode Rayleigh waves are in many instances vigorously generated in these circumstances. An analysis of recordings of the Love waves and the higher-mode Rayleigh waves identified several more of the problem events as earthquakes.

Only a single sequence of events at one place in Tibet remained as a problem. In that region underground nuclear testing is unlikely, but the nature of the events could not be determined with certainty from the magnitude ratios. We think the reason is that with the seismographic networks of the 1960's, when the events were recorded, Love waves could not be detected for small-magnitude events because they were obscured by background earth noise. New installations and new modes of data processing have greatly reduced the problem. If the same series of events or a similar series were to take place today, we think they would be identified unambiguously. Long-period seismographs in boreholes and routine digital processing of seismograms lead to a suppression of background noise and increase the detectability of many types of waves, including Love waves.

As it happened, the nature of the Tibetan problem sequence was resolved in spite of the inadequacies of the long-period data of the time. At several stations the first motion of the *P* waves was downward, which is not possible for an explosion. Hence the events must have been small earthquakes.

It seems reasonable to say that for the networks we shall describe below there should no longer be any problem events at $m_b$ 4 or more. We know of no Eurasian earthquake with a one-second *P*-wave magnitude of 4 or more in the past 20 years whose waves are classified as those of an explosion. (Of course, numerous smaller Eurasian earthquakes during that period went unidentified because of inadequate data.) Furthermore, to our knowledge not one out of several hundred underground nuclear explosions set off in the same period radiated seismic waves that could be mistaken for those of an earthquake. Our experience indicates an extremely low probability that an event will remain unidentified when all the available techniques of discrimination are brought to bear.

No monitoring technology can offer an absolute assurance that even the smallest illicit explosion would be detected. We presume that an ability to detect and identify events whose seismic magnitude is equivalent to an explosive yield of about one kiloton would be adequate. It is often assumed that for the U.S. to subscribe to a comprehensive test ban it would require 90 percent confidence of detecting any violation by another party to the treaty. Developing a new nuclear weapon, however, generally requires a series of tests, and the probability that at least one explosion will be detected rises sharply as the number of the tests is increased. Moreover, a 90 percent level of confidence for the detection of even a single explosion probably is not needed. For a country seeking to evade the treaty the expected probability of detection would certainly have to be less than 30 percent, and perhaps much less, even if only one illicit test were planned. The test-ban agreements that have been considered over the years all include an "escape clause" through which a country could renounce its treaty obligations. Unless the probability of detection were very low, a country whose national interest seemed to demand a resumption of testing would presumably invoke the escape clause rather than risk being caught cheating.

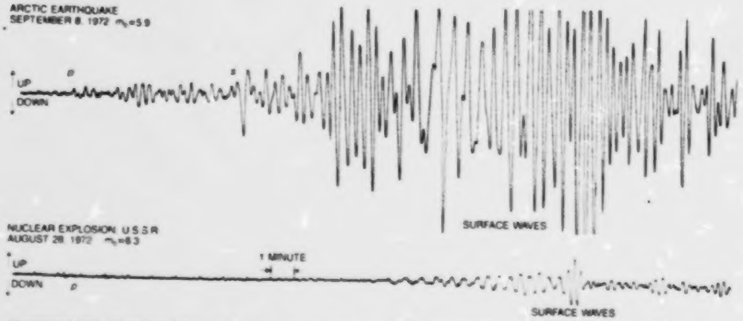
Given these standards of reliability for a monitoring system, it is possible to specify the size and the sensitivity of the seismic network that would be needed to verify compliance with a comprehensive test ban. Two kinds of network can be considered for maintaining seismic surveillance of the U.S.S.R. One network consists of 15 stations outside the borders of the U.S.S.R. In the second network the 15 external stations are supplemented by 15 internal ones.

The ultimate limit on the detection of seismic signals is imposed by microseisms, or random vibrations of the earth's surface. Most microseisms are induced by the earth's atmosphere and oceans. In order to detect a one-kiloton explosion in much of the U.S.S.R. a monitoring network would have to be able to recognize above the background noise any event with a short-period *P*-wave magnitude of 3.8 or more. In order to distinguish an explosion from an earthquake by comparing the long-period magnitude with the short-period one, the network would also have to be able to detect surface waves with an $M_S$ magnitude of 2.5 or more. The network of 15 external stations could achieve these goals. Indeed, since almost all the seismic areas of the U.S.S.R. are along its borders, the external network would be sensitive to events of even smaller magnitude there. The mere detection of a seismic event in most areas of the interior would constitute identification of the event as an explosion.

The lower limit of one kiloton on the yield of an explosion that could be detected by an external network is based on the assumption that the coupling between the explosion and the seismic radiation is efficient and that the explosion was not set off during or soon after a large earthquake. If one must consider the possibility that a country would try to evade a test-ban treaty by decoupling, or muffling, an explosion and thereby reducing the amplitude of the emitted seismic signals, an improved network would be required. In principle such muffling could be done by detonating the explosion in a large cavity or by using energy-absorbing material in a smaller cavity. The former stratagem might reduce the seismic signal of an explosion by 1.9 magnitude units as measured by one-second *P* waves (that is, by $m_b$). The latter stratagem might bring a reduction of one unit.

The use of an oversize cavity is clearly the more worrisome possibility, but it could be attempted only in certain geologic formations: a salt dome or a thick sequence of bedded salt deposits. Few areas of the U.S.S.R. have deposits of salt in which the construction of a cavity large enough for decoupling a several-kiloton explosion would be possible. The maximum size of a cavity that could reasonably be constructed and maintained sets a limit of two kilotons on explosions that might be muffled in this way and escape detection by the 15-station external network.

Another way to reduce the amplitude of radiated seismic waves is by detonating an explosion in a low-coupling medium such as dry alluvium. The maximum thickness of dry alluvium in the U.S.S.R. sets a limit of 10 kilotons on explosions that might be concealed by this means, again assuming that only the 15 external stations were installed.



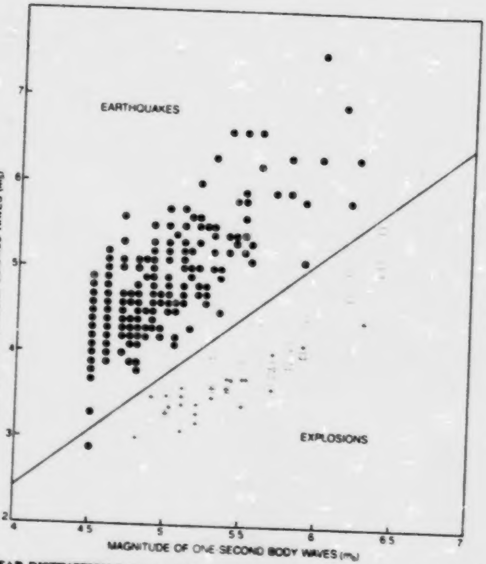
**SEISMOGRAMS OF LONG-PERIOD WAVES** from an earthquake in the Arctic near the U.S.S.R. (*top*) and an underground nuclear explosion in the U.S.S.R. (*bottom*) were recorded at a seismic station in Elath, Israel, roughly equidistant from the two events. The short-period body waves generated by the two shocks were observed to have almost the same magnitude. The magnitude of the long-period Rayleigh waves recorded in these traces, in contrast, is clearly much greater for the earthquake than it is for the explosion. The ratio of long-period surface waves to short-period body waves has been shown to be a reliable criterion for distinguishing the seismic waves of earthquakes from those of explosions. In addition the *P* wave of the explosion has more high-frequency energy than the *P* wave of the earthquake. The *S* wave of the earthquake is large, whereas that of the explosion is small and not easily identified in the seismogram.

Another possible drawback of an exclusively external network should be mentioned. Confusion could arise when signals from two or more earthquakes reached a station simultaneously. The effect would be most troublesome when the long-period waves from a small event in the U.S.S.R. arrived at the same time as similar waves from a much larger earthquake elsewhere in the world. Under these circumstances it might be difficult to establish with certainty by comparing $M_S$ with $m_b$ the identity of the event in the U.S.S.R. With a network of 15 external stations there would be a few events per year in which the smaller earthquake was in the territory of the U.S.S.R. or within 25 kilometers of its borders and at a depth of less than 50 kilometers.

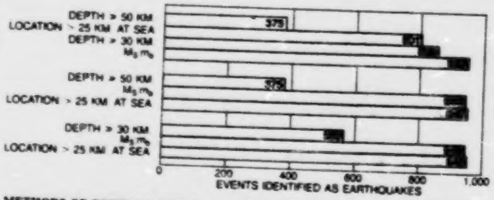
A monitoring network made up of 15 seismographic stations outside the U.S.S.R. and 15 inside it would largely eliminate the problem of coincident earthquake signals and would greatly reduce the maximum yield of an explosion that might escape detection, even if decoupling were attempted. The internal monitoring stations would be simple unattended ones, with the capability of measuring vertical ground motion and two orthogonal components of horizontal motion, so that the distance and direction of a nearby event could be estimated from the data of a single short-range station. With such a network in place, and assuming that muffling was attempted in the presence of normal earth noise, the largest explosion that would have a 30 percent chance of escaping detection in any setting except a salt dome would be .5 kiloton.

For salt domes the main area of concern in the U.S.S.R. is the region north of the Caspian Sea. Our hypothetical network has three stations there. Even a small explosion in a large salt-dome cavity would emit certain *P* and *S* waves with an amplitude large enough to be detected by nearby stations. Furthermore, detection by even one of the stations would immediately identify the event as an explosion because the area has no natural seismic activity. As a result evasion would not be likely to be attempted at a yield greater than one kiloton even in the salt-dome area.

A possible strategy for evasion that has been mentioned from time to time is the one of hiding the seismic signal of a nuclear explosion in the signal of a large earthquake, which might be near the site of the explosion or far from it. For the U.S.S.R. the only credible possibility is a distant earthquake because the only possible testing sites where earthquakes are frequent enough to make the effort worth while are on the Kamchatka Peninsula and in the Kurile Islands. Clandestine testing there is not likely because seismic activity in the area can be moni-



**CLEAR DISTINCTION** between earthquakes and explosions is evident in this plot of the magnitude of long-period surface waves ($M_S$) against that of short-period body waves ($m_b$). The 383 earthquakes represented by the black dots were compiled from a set of all the earthquakes recorded worldwide in a six-month period that had an $m_b$ value of 4.5 or more and a focal depth of less than 30 kilometers. (There are fewer dots than earthquakes because the magnitudes of some of them coincided.) The colored squares designate underground explosions in the U.S. and the colored crosses underground explosions in the U.S.S.R. Only one earthquake falls within the explosion population, as defined by the straight line separating the two groups of events. This single event, which had the smallest magnitude of any of the earthquakes in the survey, took place in the southwest Pacific Ocean, a region where the sensitivity of the network of seismic stations is poorer than it is in most of the Northern Hemisphere. The $m_b$ values were adjusted to take into account regional variations in the amplitudes of short-period waves.



**METHODS OF DISTINGUISHING** earthquakes from explosions were tested by applying the methods to all the earthquakes with a magnitude of 4.5 or more recorded during a 162-day period in 1972. The sample consisted of 948 events. Many of them could be classified as earthquakes (rather than explosions) by their location or their depth. The remaining events could be classified by comparing the magnitude of long-period surface waves with the magnitude of short-period body waves (the ratio $M_S$ : $m_b$). The sequence in which the tests were applied affected the efficiency of the procedure, but all events were identified regardless of the sequence.

tored in detail from stations in Japan and the Aleutian Islands. Indeed, ocean-bottom seismometers and hydroacoustic sensors could be placed just offshore.

The first defense against evasion by the masking of a test in a large earthquake is the questionable feasibility of the subterfuge. Unless the evader maintained several testing sites the number of opportunities per year for clandestine testing would be quite limited. In addition the evader would have to maintain his weapons in constant readiness for firing. To attain the evasion capability given below he would have to set off an explosion within 100 seconds of the time of arrival of the short-period waves of the earthquake. He would have to estimate the maximum amplitude and the decay rate of the earthquake waves with high accuracy, and he would have to be certain of the amplitude of the *P* waves generated by the explosion to within .1 magnitude unit. Even after taking these precautions the evader would have to accept a high probability that the event would be detected by at least one monitoring station and a small probability that three stations would detect it. He would also have to install and operate his testing site (including a large cavity) and his own seismological network in total secrecy over a period of years.

In contrast to these daunting requirements for successful evasion, the only requirements for a monitoring nation are to operate a network of high-quality seismic stations and to process the data with determination. Against a network of 15 external stations and 15 internal ones the only effective evasion schemes at yields of one kiloton or more would require both decoupling and hiding the explosion signal in an earthquake.

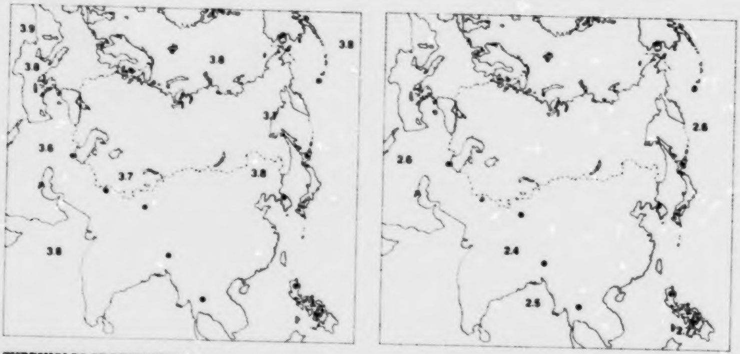
The issues relating to the monitoring of a comprehensive test ban can be summarized as follows. The understanding of seismology and the testing of seismometer networks are sufficiently complete to ensure that compliance with a treaty could be verified with a high level of confidence. The only explosions with a significant likelihood of escaping detection would be those of very small yield: less than one kiloton provided the monitoring system includes stations in the U.S.S.R.

It is important to view the question of yield in the context of the nuclear weapons that have been tested up to now. The ones that ushered in the nuclear age in 1945 had a yield of from 15 to 20 kilotons. Yields increased rapidly to the point where the U.S.S.R. tested a 58,000-kiloton weapon in 1961. The largest underground explosion had a yield of almost 5,000 kilotons. Unclassified reports place the yield of the weapons carried by intercontinental missiles in the range from 40 to 9,000 kilotons. The yields of underground explosions that might go undetected or unidentified under a comprehensive test ban are therefore much smaller than those of the first nuclear weapons. If the threshold of reliable detection and identification is one kiloton, that is only one-150th of the limit specified by the Threshold Test Ban Treaty of 1976.

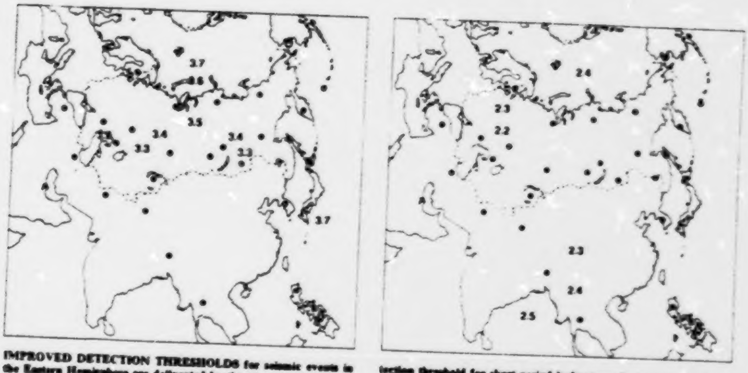
From the viewpoint of verification a comprehensive test ban would actually establish the equivalent of a very low threshold, since weapons of extremely low yield could be tested underground without the certainty of being detected and identified. A treaty that imposed a threshold near the limit of seismological monitoring capability might therefore be considered an alternative to a comprehensive test ban. Such a treaty might be preferable to the present quite high threshold, but it would have the disadvantage that arguments could arise over the exact yield of tests made near the threshold. Indeed, the judgment of whether or not a test has taken place will always be less equivocal than an exact determination of yield.

In recent years there have been reports that the U.S.S.R. may have repeatedly violated the 1976 treaty by testing devices with a yield greater than the 150-kiloton limit. Such reputed violations were recently cited as evidence that the threshold treaty, which has not been ratified by the U.S. Senate, is not verifiable and should be renegotiated. On the basis of our analysis we conclude that the reports are erroneous; they are based on a miscalibration of one of the curves that relates measured seismic magnitude to explosive yield. When the correct calibration is employed, it is apparent that none of the Russian weapons tests exceed 150 kilotons, although several come close to it.

Observations at the Nevada Test Site (NTS), where American nuclear-weapons tests are held, indicate there are lin-



**THRESHOLDS OF DETECTION** for seismic events in the Eastern Hemisphere are delineated by the two sets of contours drawn on this pair of maps for a proposed network of 15 seismic stations established outside the U.S.S.R. Colored dots give the location of 12 of the 15 stations; three others are off the maps. The number on each contour indicates that an event of that magnitude or larger has at least a 90 percent probability of being detected by four or more stations. The contours on the map at the left represent the detection thresholds for short-period body waves and those on the map at the right the detection thresholds for long-period surface waves. On these maps and the ones on the opposite page the only seismic noise taken into account is the microseismic noise generated by the atmosphere and oceans.



**IMPROVED DETECTION THRESHOLDS** for seismic events in the Eastern Hemisphere are delineated by the two sets of contours drawn on this pair of maps for a proposed network of 30 seismic stations: 15 outside the U.S.S.R. and 15 inside. For most of the U.S.S.R. the effect of adding the 15 interior stations would be to lower the detection threshold for short-period body waves from a magnitude of 3.8 to one of 3.4 (*left*); the corresponding effect for long-period surface waves would be to lower the detection threshold from a magnitude of 2.6 to one of 2.3 (*right*). The interior stations would also provide more accurate information on the focal depth of a seismic event.

ear correlations between the logarithm of the explosive yield and the two magnitude values, $M_S$ and $m_b$, for explosions with yields greater than 100 kilotons. When the measured $M_S$ and $m_b$ values of explosions at the Russian test site near Semipalatinsk are inserted into the NTS formulas, however, the resulting estimates of yield given by $m_b$ are more than four times as great as those given by $M_S$. For explosions in hard rock at many test sites estimates of yield based on the NTS $M_S$ formula have invariably agreed with actual yields, whereas estimates based on the NTS $m_b$ formula have sometimes been in drastic disagreement with the actual yield.

A strong correlation has been found between $m_b$ values measured at individual stations and *P*-wave travel times to these stations. The U.S.S.R. routinely publishes seismological bulletins that include *P*-wave arrival times of earthquakes, and it is straightforward to interpret the times for stations in central Asia in terms of the expected pattern of $m_b$ values near Semipalatinsk. From an analysis of the *P*-wave signals it is predicted that the $m_b$ value for an explosion at Semipalatinsk is 40 percent greater than an equivalent explosion at NTS. This is the same correction that must be applied to the curve relating $m_b$ to yield at NTS to make the $m_b$ estimates of the yield of Russian explosions consistent with the $M_S$ estimates. Thus two modes of analysis lead to the conclusion that there is an essentially universal relation between $M_S$ and yield whereas the curve relating $m_b$ to yield must be calibrated for each test site.

A comprehensive treaty would have an additional advantage over a low-threshold treaty: all technological uncertainties would work against the potential evader. A country planning a surreptitious nuclear test could not know the exact seismic-detection capability of other nations or the exact magnitude of the seismic waves that would be generated by his test. A ban on nuclear explosions of all sizes would also have the important conceptual value that nuclear weapons, no matter what their size, would be recognized as inherently different from conventional weapons.

It is sobering to consider how the state of the world would differ if a full test ban had been achieved in 1963. The number of nuclear weapons has grown tremendously since then and is now estimated at from 50,000 to 100,000. The loss of life and the social damage that would be inflicted in a major nuclear exchange are vastly greater than they were in 1963. Furthermore, both the U.S. and the U.S.S.R. are less secure now than ever before, not because of any failure to develop arms but because of the growing stockpiles of weapons and the inability of any nation to defend itself against nuclear attack.

A comprehensive test-ban agreement should not be regarded as a substitute for disarmament. Meaningful reductions in the nuclear threat must include a continuing and serious process of arms control; in this process, however, a comprehensive test-ban treaty could have an important part. The problems of negotiating such a treaty are overwhelmingly political rather than technical and must be recognized as such.

Before the suspension of negotiations between the U.S., Britain and the U.S.S.R. in 1980 tentative agreement had been reached on a number of issues. All three nations agreed that a test-ban treaty would include a prohibition of all tests of nuclear weapons in all environments, a moratorium on peaceful nuclear explosions until arrangements for undertaking them could be worked out, provisions for on-site inspections, a mechanism for the international exchange of seismic data and the installation of tamperproof seismic stations by each country in the territory of the others. The proposed treaty would have a term of three years. The agreements on the long-standing issues of on-site inspection, peaceful explosions and the placement of monitoring stations in each country represented important breakthroughs. It would be a setback for the cause of international security if this hard-won ground were now lost.

For many years the stated policy of the U.S. has emphasized the desirability of a complete test ban if verification could be ensured. The policy was not fundamentally altered by the recent decision of the Reagan Administration to put off further negotiations on the test ban. On the contrary, it was reported that the Administration still supports the ultimate goal of a comprehensive ban on nuclear testing but has doubts about the efficacy and reliability of seismic methods of verification. As we have attempted to show here, there can be no substance to such doubts.

## The Authors

LYNN R. SYKES and JACK F. EVERNDEN are geophysicists who in addition to their scientific work have spent considerable time on means of distinguishing underground nuclear explosions from earthquakes. Sykes is Higgins Professor of Geological Sciences at Columbia University and head of the earthquake studies group at the university's Lamont-Doherty Geological Observatory. His B.S. and M.S. were both awarded in 1960 by the Massachusetts Institute of Technology. His Ph.D. in geology was granted in 1964 by Columbia and he has remained at the university since, taking up his present jobs in 1971. Sykes's scientific work has centered on plate tectonics, including the plate-tectonic structure of Asia, which may be significant in the verification of a test-ban treaty. Evernden is program manager of the U.S. Geological Survey's National Center for Earthquake Research. His B.S. in mining geology (1948) and his Ph.D. in geophysics (1951) are from the University of California at Berkeley. He writes: "I, of course, agree with all conclusions presented in this article, but that agreement should not be construed as acceptance of those conclusions by either the U.S. Geological Survey or the United States Government."

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## ERRATA TO SYKES AND EVERNDEN SCIENTIFIC AMERICAN PAPER

Page 8, near the bottom of column 3 should read:

The maximum size of a cavity that could reasonably be constructed and maintained sets a limit of ten kilotons on explosions that might be muffled in this way and escape detection by the 15 station external network.

Another way to reduce the amplitude of radiated seismic waves is by detonating an explosion in a low coupling medium such as dry alluvium. The maximum thickness of dry alluvium in the U.S.S.R. sets a limit of two kilotons on explosions that might be concealed by this means, again assuming that only the 15 external stations were installed.

Page 11, first column, 12 lines from bottom, change 40 percent to 0.4 magnitude units.

Mrs. **Byron**. Thank you very much, Dr. Sykes.

Let me follow up a little bit on a question. Do you have any thoughts on the 50-percent reduction that has been proposed on the table in Geneva with the verification problems that are going to be the final stumbling block on any proposal?

Dr. **Sykes**. I will suppose that that would involve a reduction in the number of large missiles and of the weapons emplaced on those. So although I am not an expert in that subject of verification, I would foresee no problem there.

Mrs. **Byron**. If the case can be made that effective verification is more a question of political interpretation, than the scientific interpretation—which is the theory that some people hold, you obviously are on the other side of that with the scientific aspect—should this administration with a clearcut case for Soviet violations on other arms control measures over the last decade negotiate a comprehensive test ban treaty with the Soviets without getting the agreement on verification first?

We have in this country such an open policy that verification really isn't something that we give up because we really don't have verification in the first instances because with our openness it is very simple to do verifications.

I question what caliber of a bargaining chip or an issue we could give for getting the verification.

Dr. **Sykes**. Well, I believe that verification should be an essential and integral part of a treaty negotiated with the Soviet Union, and as part of those negotiations.

It certainly was a major object of the U.S. delegation from 1977 to 1980 in negotiating toward a comprehensive treaty. But I think it is very clear that the United States must make a very vigorous and determined monitoring effort if we are to have a comprehensive treaty or a low yield threshold treaty.

Mrs. **Byron**. But with our openness, verification on our side is a moot issue so to speak for us. With the Russian closed society the verification is a very high profile issue for us to achieve in any type of talks.

I think when you come right down to making the final assessment we have already given up verification as an issue, because of the openness. Would that be a stumbling block?

Dr. **Sykes**. Well, I have stated that for example we can get much improved verification if we have United States seismic listening posts in the Soviet Union. There will obviously be a tug of war in any negotiations between what we might ultimately wish to have—that is many more sophisticated stations—than we are likely to get under any agreement. Then it is a question of what will be adequate for our monitoring purposes?

I think there is no question that we have to be able to verify what is going on in the Soviet Union and that these methods provide a way of doing that reliably down to a very low level.

Mrs. **Byron**. Mr. Spratt.

Mr. **Spratt**. Madam Chairman, I yield to Mr. Mavroules.

Mr. **Mavroules**. Thank you, Mr. Spratt.

I have to get these two questions in. I do have an appointment at 12 o'clock. In your judgment—and I ask for advice from both of you—do you feel if we had a comprehensive test ban treaty that the security of the United States would be to a lesser degree, and can we indeed—if I could get a straight answer perhaps on what we must do to verify a comprehensive test ban treaty?

### VERIFICATION OF A COMPREHENSIVE TEST BAN TREATY

Dr. **Sykes**. Yes, I think I have spoken extensively to the idea that we can verify a comprehensive test ban treaty. It will take a determined monitoring effort. We should not underestimate that. It is not something that I can gaze into a large ball and tell whether the Soviets are testing.

We will have to spend considerable sums of money if we want to have a capability against the Soviet Union.

Mr. **Mavroules**. But it can be done?

Dr. **Sykes**. If we want a capability world wide, we merely have to buy that capability. I feel there is no question that that can be done. There will always be some lower limit, and Congress must then ask the question, is that a lower limit that is acceptable or not? Or to take another alternative that of lowering the threshold, with appropriate verification measures, in a treaty down to a much lower level than the present Threshold Treaty.

Mr. **Mavroules**. Would you care to address the other question, would the security of the United States be threatened today if we had a comprehensive test ban treaty?

Dr. **Sykes**. No, I certainly don't think that it would. I think it would be enhanced. If we look back to 1963, we can see the many weapons that have been developed since that time. Certainly a comprehensive treaty in the 1960's would have put a major lid on the Soviet development of multiple warhead missiles, of cruise missiles by both countries, the neutron bomb and many other important weapons, particularly ones that involved a serious reconfiguration of the weapons that were involved.

Today we have the example of the x-ray laser, of a quite new type of weapon that if we were to have that weapon it must be tested extensively. The comprehensive test ban would put a limit on that.

Mr. **Mavroules**. Thank you very much. I also want to thank my colleague, Mr. Spratt, for yielding.

Mrs. **Byron**. Mr. Spratt.

Mr. **Spratt**. Thank you, Bill, for appearing. I have a couple of questions of your excellent testimony.

Dr. Sykes, you say at one point in your testimony that we have miscalibrated—someone has miscalibrated—in using the formula for extrapolating the explosive yield from seismic magnitudes to show up on the sensing devices. Who has miscalibrated?

Dr. **Sykes**. The United States does have an official way in which this is done. The actual procedure and the formula that is used is classified. But all of the techniques for estimating what is the correct way of doing this are all within the public domain.

Mr. **Spratt**. You say there is near unanimity at this time about the relationship between seismic phenomena and explosive yields, however, if I understand your testimony correctly, you were also saying we are using a formula which most geologists would not accept.

Dr. **Sykes**. That is correct. I hope that we are on the way to making a serious revision in that policy.

Mr. **Spratt**. Which agency is responsible for deciding on the methodology?

Dr. **Sykes**. I think there is a problem there in a sense and one of the reasons this debate has gone on for 10 years, is that there is no Government agency that has it as their responsibility for asking the question what is the best methodology for doing this and of taking overall responsibility throughout the Government.

There have been interagency committees that have debated this and other areas that involve science and technology; there is not an agency that clearly has that responsibility.

For example, the Lawrence Livermore National Laboratory, one of the two national weapons laboratories, has a large group of people that have worked on yield estimation. They don't believe the Soviet Union has violated the threshold treaty.

Other agencies, two different groups in the Department of Defense, have responsibility in this area but not one is charged with coming up with the best method of doing this.

Mr. **Spratt**. Which agency is best equipped to come up with the method? If you had to assign that responsibility to a particular agency, CIA, DIA, NSA, one of the labs? Which one would you choose?

Dr. **Sykes**. I think that I would advise, for example, going to the Arms Control and Disarmament Agency which at the present time does not have the capability of doing that, but I think that we would probably have the least conflict of interest if we could charge them specifically and give them the funds that are necessary to do the job of ascertaining what is the best scientific methodology of doing this.

Mr. **Spratt**. Mr. Colby, do you have any comments on agencies?

Mr. **Colby**. I agree entirely. I think the idea of having a policy agency such as the Arms Control and Disarmament Agency would make sense and let it be supported by the various intelligence and technical agencies. But let it make the policy judgment.

Mr. **Spratt**. We have had other witnesses who have told us that if we have a comprehensive test ban, most of these witnesses have come from the national labs, but that there would be certain disadvantages to the United States.

First of all, after a period of time, we would no longer be able to judge the reliability of our nuclear arsenal; second, the third generation of systems in some cases toward which we are moving are potentially more stabilizing systems.

And finally there seems to be a feeling that there would be a morale problem within the labs particularly in attracting and retaining the best physicists to work in the area of our nuclear weapons and that if they would be confined solely to working on computer models and simulations they would soon move into other fields and move away from these areas.

Could you comment on these disadvantages or stated disadvantages of a comprehensive test ban?

Mr. **Colby**. Well, on the maintenance of reliability I think that we have to say that the way these are put together and tested before they are used we certainly have an adequate sense of their

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reliability, and the qualities of the chemicals and other things put into them, certainly I think we have a quality control of that.

I am not technically qualified to categorize exactly what reliability tests should be undertaken on those, but I think there are alternatives to exploding one that one should be able to get a reasonable kind of reliability sense. On the two other reasons, the one, the third generation, the whole idea of the test ban would be to stop a third generation. That is the usual argument that the next weapon is going to be better.

Well, better from all sorts of ways, but the fact is that we have got these, let's not go further. And the third one, I think you can attract sufficient efficient people to do what is necessary in this field in this country. No question about it. But maybe Dr. Sykes would like to comment.

Dr. SYKES. I think on the reliability question that I am impressed as I stated earlier that there are two quite divergent views on that matter. Certainly I trust the scientific credentials of the group that has said that these weapons will work a long time into the future providing there is sufficient nonnuclear testing and remanufacturing of components.

Yet nonetheless, we have heard serious reservations about that point of view. I think that those questions are largely technical and scientific and I think now is the time for Congress to seek as independent a viewpoint as it can on this particular matter.

On the question of morale, I have suggested for example that a low-yield threshold treaty would be a serious alternative to a comprehensive test ban treaty. This would allow the weapons laboratories for example to continue a program of atomic testing, admittedly at low yields, but they would not have the morale problem that they would have with a full comprehensive treaty.

Mr. SPRATT. Dr. Sykes, do I understand your testimony to say the Threshold Test Ban Treaty has actually inhibited the Soviets from taking full advantage of their heavy throw-weight missiles?

### THRESHOLD TEST BAN TREATY INHIBITS THE SOVIETS

Dr. SYKES. That is correct. This is something that has not been appreciated, I believe. Many of us did not think initially that the threshold treaty would have the impact that I believe that it has had. For example, in his testimony of May 8, Dr. Donald Kerr of the Los Alamos National Laboratory, indicated with testing at 150 kilotons that it is possible to reliably test weapons that could be deployed up to 300 kilotons. In other words, a factor of two, but not larger.

If you look in the paper I have attached as an appendix, you will see that there is this major peak in Soviet testing at 500 kilotons. You have to go down all the way to 150 kilotons before you find another peak in that diagram.

So there is a broad area in there in which the Soviets have not tested at all, not ever, at least underground since 1963.

So if Dr. Kerr's testimony is correct, it would not appear that they can reliably test a new lighter weight 500-kiloton weapon or a lighter weight weapon of that size.

So I think it is very important for the United States security that the Soviets be constrained from placing more lighter weight weapons of that size, 500 kilotons, on their large intercontinental missiles or placing larger weapons of, say, 1,000 kilotons on those systems.

Mr. SPRATT. In view of the clustering of data around 500-kiloton tests in the mid-1970's, while the SS-18 and SS-19 were being developed, are you inferring from that data that the Soviets don't have 750-kiloton warheads on their SS-18 or RV's?

Dr. SYKES. That is right, and if you look at my diagram, you will see that there is that huge peak at 500 kilotons. In addition, there was a 21-month period between the signing of the Threshold Test Ban Treaty in July 1974 and the date that it entered into force in 1976. The Soviets tested three of those 500-kiloton weapons in that particular timeframe.

Surely, both they and the United States knew that they had 21 months in which to conduct any very large tests of new weapons that they wished to do before the treaty entered into force or to do any proof testing of very large weapons.

The Soviets tested no weapons between 75 and 500 kilotons in that 21-month interval.

So, I take it that 500 kilotons is an exceedingly important weapon or weapons to them.

Mr. SPRATT. Finally, if I understand your testimony correctly, you are saying that there really are no sites in the continental United States where we would want to test warheads in excess of 150 kilotons.

Dr. SYKES. That is not quite right.

We have done testing of up to about 1 megaton or 1,000 kilotons at the Nevada Test Site.

Testing of that size, then, is very noticeable in Las Vegas and other places in Nevada. The reason that the United States had to go up to Amchitka, a very remote island in the Aleutians, was to test the much larger weapons that were done there, particularly the large Cannikin explosion in 1971.

So, for tests of more than about a megaton, we do have to go outside of Nevada.

Mr. SPRATT. Whereas, the Soviet Union has ample test sites, I suppose, in central Asia for tests in excess of that magnitude.

Dr. SYKES. In Central Asia, since the threshold treaty went into effect, they have been doing all of their tests of around 150 kilotons there.

They have still kept one of their Arctic test sites in use which would be in accordance with the treaty.

They have tested less than 150 kilotons there, but it is that same place where they tested all of these much larger weapons underground from 1964 to 1976.

Whereas, the United States has not tested at Amchitka, it would presumably be much easier for the Soviets to resume testing of large weapons at their Arctic test site.

Mr. SPRATT. The Soviets have, in Asia, large gas deposits. Do they have, as we have in this country, underground caverns which they have created in granite locations for the storage of propane or liquid natural gas?

Dr. **Sykes**. Right, they do have such caverns. In fact, some have been created by atomic explosions.

Mr. **Spratt**. Would some such caverns be useful or convertible to an underground test site that might be used to muffle the seismic waves coming out of it?

Dr. **Sykes**. I think we would certainly want to take that as a possibility under a comprehensive test ban looking very carefully at these cavities.

We know where they are from the explosions done there, detonated there. It turns out that those are in areas in which we do know these high frequency waves propagate, very readily, long distances to Norway.

The United States would certainly be advised under a comprehensive treaty to place more stations around those areas in which there are large thicknesses of salt or where some of these cavities exist.

Mr. **Spratt**. Is the size of these underground caverns sufficient to create problems with seismic detection?

You were describing the volume of rock that had to be excavated, the cubic volume that has to be cleared out as something equivalent to a pyramid.

Do these caverns approach in cubic volume——

Dr. **Sykes**. There are a few that approach that in size, but if we get these stations within the Soviet Union, we could get the capability that they talked about, of 1 kiloton, even if they attempted tests in those cavities.

Mr. **Spratt**. Thank you very much.

Mr. **Byron**. Mr. Courter.

Mr. **Courter**. Thank you very much.

I find your testimony interesting, Dr. Sykes.

I wonder if you could answer the question that I have. It is my understanding that any type of comprehensive test ban treaty would not prohibit testing for peaceful purposes.

### TESTING FOR PEACEFUL PURPOSES ALLOWED

Dr. **Sykes**. Yes.

Mr. **Courter**. The United States and the Soviet Union—particularly the Soviet Union—have engaged in a number of tests that they allege were for peaceful purposes and not military.

How do you distinguish the difference between a peaceful test and one used for military purposes?

Dr. **Sykes**. You can't do this through seismic purposes. It is for that reason that an important ingredient under a comprehensive treaty is to have some treaty stipulations dealing with peaceful explosions.

The Soviet Union had agreed by 1980 in the published document of the three countries at that time that there would be a moratorium on peaceful explosions until such time as the detection means and identification means could be put together that would ensure that those were not weapons tests.

Mr. **Courter**. Basically, if I can extrapolate from what you said, the Comprehensive Test Ban Treaty, even with verification levels that you anticipate, is not advisable unless there is, as well, an agreement to prohibit any tests?

Dr. SYKES. It will make a very big difference where the language that is in there says "nuclear weapons tests" or its says "atomic tests" altogether.

So, it is important that there be a distinction there.

The threshold treaty of 1974 only deals with weapons tests, and the companion Peaceful Nuclear Explosions Treaty treats the comparable problem for peaceful explosions.

We have to make sure that that issue is covered under a comprehensive treaty.

Mr. COURTER. In other words, what I am saying—and I wonder if we can be precisely on the same wavelength here—because there are a number of people that say, in their position, that we should negotiate a comprehensive test ban treaty with the Soviet Union and at the same time not prohibit nuclear explosions related to peaceful scientific inquiry or for civilian projects.

My question to you is, is that advisable? If you take the position that a comprehensive test ban is an advisable policy step for the United States, then a fortiori you have to ban any other type of nuclear detonation, because one obviously cannot determine whether it is being monitored or being tested for military purposes.

Dr. SYKES. Right. Certainly, we would be very distraught under a comprehensive treaty if the Soviet Union tested 100 kilotons and said, "Oh, by the way, that is a peaceful explosion."

So, obviously, that matter has to be covered.

Mr. COURTER. So, I want to be really firm on your position because I think it is very important.

Your position is that it is not advisable to have a simple comprehensive test ban treaty with the Soviet Union. You have to have a comprehensive test ban that covers peaceful nuclear explosions, as well.

Dr. SYKES. Yes, I believe so.

Mr. COURTER. Thank you. It is my understanding you had—and have—a formula to determine yield from seismic activities, and from that formula you make a determination as to, in fact, the yield of the test.

Has your formula been provided to any branch of government to determine whether they agree with that formula?

Dr. SYKES. Well, for example, two of us published a paper in 1984 using mainly a different type of seismic wave, so-called long surface waves, for estimating yields.

And one of the panels of the Defense Department, DARPA's panel, has reviewed that extensively.

From information given to the press recently, it indicates that that method has now come of age.

There is one particular problem of a certain contaminating effect called tectonic release that we now feel we know how to estimate and how to remove that contaminating effect so that we can get better estimates of yield using surface waves.

Mr. COURTER. Let me go about it this way, because it is quite technical.

Is there a difference of opinion in the scientific community as to the proper formulation of determining yield from seismic activity, or is everybody in agreement?

Dr. SYKES. I think that virtually everyone is in agreement. That is not saying that there are not one or a few people who are not in agreement there.

But for that matter, I would certainly advise that the panel get some type of report of three classified studies that I they mentioned earlier that specifically address these problems.

There is a great deal of new information and new findings on those subjects that are classified.

Mr. COURTER. You indicated in your testimony that by the placement of 15 monitoring stations outside the Soviet Union—or if this is not in your testimony, I think it is in your written presentation—by placement of 15 monitoring stations outside the Soviet Union, you could have extremely high confidence that no test could be conducted even in salt domes or other types of vacant areas that would be more than 10 kilotons, is that correct?

Dr. SYKES. That is correct, and that 10 kilotons is set by the larger size of underground openings that can be created and maintained in a clandestine fashion.

Mr. COURTER. Do you know where these monitoring devices would be placed? Obviously, they would have to be very strategically placed in order to pick up the information that you need.

### PLACEMENT OF MONITORING STATIONS

Dr. SYKES. Certainly. For example, for a high frequency capability you want to have those stations either in Europe or Asia. You don't want the waves traversing across continental boundaries or across major mountain systems, such as the Himalayas. So you want to place them strategically to better pick up certain waves.

Mr. COURTER. In your studies did you come up with a precise location as to where you would put the 15 monitoring stations for that purpose?

Dr. SYKES. We made some suggestions there. There are certain worldwide stations for which the data is freely available that we know of their capabilities. We know, for example, that the British have operated several moderate size seismic arrays of many sensors that are in some of those parts of the world. We know those capabilities.

Mr. COURTER. You would then go and say that if you placed a certain number of seismic devices inside the Soviet Union, that you could increase your capability to have high confidence with respect to sizes of nuclear explosions down to one kiloton?

Dr. SYKES. That is correct.

Mr. COURTER. Is there a difference of opinion, to your knowledge, in the scientific community as to whether if one country, for example, tests amply at one kiloton—and I note the testimony of Mr. Colby was saying that even if they tested at one kiloton we would soon find out. Do you agree with that?

Dr. SYKES. Providing we have those stations within the Soviet Union. If they tested at 1 kiloton I believe that we would soon find out.

Mr. COURTER. But that seems—I want to ask this very respectfully—this seems to be different from your statement than a test of less than one kiloton could be camouflaged. Now, you say you agree if they tested at about a kiloton or under, we would find out about it?

Dr. SYKES. Even if they take their best attempts to camouflage.

Mr. COURTER. If they are going to cheat that would be their best attempts to cheat.

Dr. SYKES. Right. The number that I gave you of 1 kiloton would be such that we would identify that with high confidence down to 1 kiloton.

Mr. COURTER. So anything under 1 kiloton you would not be able——

Dr. SYKES. That is correct. So there will always be some lower limit with an external network. That limit is higher, we estimate 10 kilotons. It is 1 kiloton if you get this good internal capability.

Mr. COURTER. How many seismic devices do you estimate would be necessary to be deployed inside the Soviet Union to have that degree of confidence? We are obviously not talking about a high degree of confidence, we are talking about the security that may be obtained. You are talking about making sure that there is no possibility of the United States ever testing for 50 years, and the Soviet Union carrying on lots of tests over 50 years, it can't be high confidence, it has got to be I suppose infallable when you are doing that.

The question I have is, whether there is a difference of opinion in the scientific community as to whether it would make a military significance if one country in their nuclear capability, if one country tested over years at less than 1 kiloton, and the other country did no testing at all? Is there just one opinion?

Dr. SYKES. I think that there are differences in viewpoints that several witnesses from the weapons laboratories have argued that very tiny tests, really almost no matter how small, could have military significance. It is for that reason that I have suggested having a low-yield threshold treaty if there is serious reservation about that matter.

Mr. COURTER. You testified that there is a serious reservation about that, is that correct? You don't have serious reservations but there is a difference of opinion in the serious scientific community on that particular issue?

Dr. SYKES. There is a representation that is made that very small tests can have military significance. There is also another representation——

Mr. COURTER. I understand there is a split in the scientific community by physicists who design warheads. Given that, your position therefore is, I assume, that you prefer a low yield test ban treaty rather than a comprehensive test ban?

Dr. SYKES. I have preferred a low yield threshold treaty. One of the main documents that is available on this question of significance is Kidder's recent article in which he does show that the United States has conducted some tests in the last 5 years that are smaller than 1 kiloton. But he talks then about presumed military significance in the eyes of those running our testing programs that they did decide to do some very small tests which presumably have some military significance. But I have yet to hear exactly how great that military significance is.

Mr. COURTER. Let me finish up with this. You would agree that it could be quite serious from a tactical standpoint if 1 side had all conventional arms and the other side had tactical nuclear explosives up to 1 kiloton in yield. It would be a disadvantage would it to that side that had no nuclear weapons?

Dr. SYKES. Certainly. We are talking about a situation in which both the United States and the Soviet Union have more than 10,000 atomic weapons that exist. So those weapons will exist.

Mr. COURTER. I suppose what I am doing is talking about 50-years from today after you get your comprehensive test ban where there is no reliability obviously on our tactical nuclear capability whatesoever after that period of time.

Mr. COLBY. May I comment on that?

Mr. COURTER. Sure.

Mr. COLBY. The idea of a 50-year program—and again I stress program, not an individual test, which is I believe what Dr. Sykes is talking about—but a program of 50 years or whatever, without our knowing about it, I find absolutely incredible because I think that our intelligence devices are going to improve over the next 50 years a great deal. They have improved enormously in the last 50 years and therefore that scenario of some great plot not coming to our attention over such an extensive time I find a bit unreal.

Mrs. BYRON. Mr. Colby, let me change the subject a little bit and get back to the existing agreements. Are you highly confident that the Soviets are not violating any of the existing arms control agreements? If so, how do you respond to the two Presidential reports on this matter? I think the Arms Control and Disarmament Agency has come out strongly in support of the two Presidential reports citing the Soviet arms control violations.

## SOVIET ARMS CONTROL VIOLATIONS

Mr. COLBY. There are a lot of activities that are quite ambiguous and I wouldn't put it past the Soviets to be violating them in particular instances. I think the question is whether these are putting the entire arms control regime at risk.

Mrs. BYRON. The assessment we have to make is the degree of the violations, and in our estimation how important they are, too?

Mr. COLBY. There can be violations out of ambiguities, there can be violations out of lack of discipline, there can be deliberate violations, they can be skirting right along the edge of what is permissible and slipping over it, consciously testing the edge to see whether we can catch them. All of those things exist. There is no question about it.

Mrs. BYRON. Well, having read both of the Presidential reports, do you feel that the violations that are cited in those reports are slipping over the edge or are minor violations or do you think they are——

Mr. COLBY. I do not believe, Madam Chairman, that we should denounce the the treaties and go on to an unconstrained race.

Mrs. BYRON. The Krasnoyarsk radar?

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Mr. **Colby**. It looks like a violation. The Soviets have almost indicated that they accept that it is by their loaded offer to stop construction on that if we will stop construction on ours. That to me indicates that they are prepared to negotiate. I don't think we ought to give them what they ask, but we should negotiate.

Mrs. **Byron**. They will stop construction on one radar if we will stop upgrading two.

Mr. **Colby**. That is a typical offer. I don't think we take it right off the top. But the fact is that the thing is now negotiable and if we didn't have a treaty it wouldn't be negotiable. There would be nothing to negotiate about.

Mrs. **Byron**. Let me ask you a little bit about the comprehensive test ban treaty, would that in your estimation preclude any research on SDI?

Mr. **Colby**. I think certain parts of SDI might be precluded as partly involving nuclear weapons up in space generating the necessary energy and that sort of thing. That clearly would be barred by it. The other nonnuclear aspects would not be affected by a comprehensive test ban.

Mrs. **Byron**. It seems to me that we should really get nailed down in a more detailed idea first what we are talking about in a comprehensive test ban treaty and then look at House Joint Resolution 3 as opposed to this body moving ahead on that resolution first.

Mr. **Colby**. We have been working on this since 1963, Madam Chairman. It seems to me we ought to have some ideas by this time on what a comprehensive test ban is. President Kennedy had an idea for it.

Mrs. **Byron**. I have some serious problems with House Joint Resolution 3.

Let me ask Mr. Spratt, do you have further questions?

Mr. **Spratt**. No.

Mrs. **Byron**. Mr. Courter.

Mr. **Courter**. No.

Mrs. **Byron**. Dr. Mansfield.

Dr. **Mansfield**. Thank you, Professor Sykes, for a very detailed statement and I have some technical questions that I would like to take up with you.

There have been recent panels evaluating, reviewing methods for estimation of yields using seismic methods from Soviet underground tests. You mentioned the DARPA panel, the DIA panel, and AFTAC panel, and there have been such in the past. Were you a member of any of those panels in this recent round?

Dr. **Sykes**. Yes; the DARPA panel, not the other two.

Dr. **Mansfield**. You briefed your results and attended the meetings, signed the report and you agree with the report?

Dr. **Sykes**. I was present. There have been two different DARPA reports. There was one that addressed the surface wave problem at which I was present, I was a member of that. There was the most recent meeting of the panel in which I was not present. I was sick on that day.

Dr. **Mansfield**. The issue here has to be the degree to which the Nevada Test Site [NTS] should be factored into the national formula for estimating yields from Soviet explosions. In particular,

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should it be on the order of 0.3 or so, which I believe is one widely accepted, or 0.4 or 0.45, that you and Dr. Evernden have spoken to a number of years, over a number of meetings of these panels.

My question is did you brief your reason for bias correction as high as 0.4 or 0.45 to the most recent panel?

Dr. **Sykes.** That number of 0.4 to 0.45 is one that Dr. Evernden has stated. I have stated publicly, in publications, that I believe it is about 0.35. My number is close to what I think a number of other people are advocating. It is a little bit higher, but only about 10 percent difference in yield. I tend to have a number that is somewhat different than that of Dr. Evernden.

Dr. **Mansfield.** This consensus that you mentioned isn't so sweeping that people agree down to 10 percent of yield, certainly?

Dr. **Sykes.** I think that we are at the point now in which the number that I advocate, 0.35, that I believe almost everyone else is advocating numbers that are like 0.3 or 0.4, and that those are differences of plus or minus 10 percent, maybe 15 percent.

Dr. **Mansfield.** A 0.1 magnitude is 25 percent of yield?

Dr. **Sykes.** That is right.

Dr. **Mansfield.** Isn't it true that 2 years ago when you were a member of the Department of Defense panel evaluating these verification questions, you were quite strong in your advocacy of the higher bias?

Dr. **Sykes.** No; I was advocating a higher bias than what the Government presently uses. But for some time I have advocated a bias of about 0.35.

Dr. **Mansfield.** The 0.35 is the bias that is used in your paper on evaluating the yield in Novaya Zemlya. Am I not correct, you suggested the same bias is applicable to the test site at Kazakhstan?

Dr. **Sykes.** That is right.

Dr. **Mansfield.** Let me go on a bit here. The method of getting this bias—correct me if I am describing this in a confusing fashion—the method of getting that bias is to compare for known explosions of high yield, surface wave magnitude, with body wave magnitude, for instance, for the U.S. tests at NTS, U.S. tests at Amchitka, establishing there be a bias of about, as you say, 0.35, between the body wave and surface wave magnitude, such as given in the figure on our paper for estimating the yields at Novaya Zemlya.

Although I described that in a casual fashion, is that roughly the way you established that bias?

Dr. **Sykes.** In that particular study we used two different types of waves. We used surface waves and got one independent determination, and then we looked at the P-waves that have this bias problem, and the way that we ascertained the bias problem from the P-waves is there have been independent studies by Kerr and others, of attenuation of seismic waves beneath various test sites by using a number of different frequencies of waves. So they have come up with estimates of that at many different test sites, and so we have then used their number, which was 0.35, as one way.

Dr. **Mansfield.** So it wasn't derived explicitly from the use of the surface wave magnitude?

Dr. **Sykes.** No. The important thing there is that once we take their result, we get a consistent result by an entirely different method.

Dr. **Mansfield**. The assumption seems to be, however, that surface waves are without bias, that there is no significant difference between surface wave magnitudes from Soviet test sites and United States test sites.

Dr. **Sykes**. That is an assumption that we made that we talked about in our document, that once you get down to 10 percent variations or so, that clearly there are variations there. We were not aiming at 10 percent types of studies but of trying to get at this problem of factors of 1.5 and 2, for example.

Dr. **Mansfield**. For the case of the Nevada Test Site, there is a difference, is there not, in the bias to be applied? There is a bias between northern and southern areas in the Nevada Test Site?

Dr. **Sykes**. Yes sir, there is a small difference there.

Dr. **Mansfield**. How large is that?

Dr. **Sykes**. We are probably talking about things of 0.5 or 0.1.

Dr. **Mansfield**. .05 to 0.1?

Dr. **Sykes**. Yes, sir, .05 to 0.1. That is clearly a case in which we have more geological variations than we know anything about at the Soviet test sites.

Dr. **Mansfield**. That is correct. However, all of our data comes from that area.

Dr. **Sykes**. That is not true. All of our data does not come from Nevada. The United States has detonated three explosions at Amchitka. We have also detonated other explosions, one explosion in Mississippi. So we can examine data from different areas of the United States. We have French tests that were done in southern Algeria for which we have information as well.

Dr. **Mansfield**. Now, you say you conclude that this method of establishing yield is going to be applicable to the Soviet test site at Shagan River and Degelen Mountain. Is it true that—I have heard it said, I ask your comment on this—at Shagan River even in cases where the ratio is small, there is still hidden tectonics that cannot be unfolded, therefore, you can't use surface wave magnitude measured from Shagan River to establish a bias for Shagan River, and that, if I remember right, a DARPA panel sometime back concluded this. Is that correct?

Dr. **Sykes**. There has been a long argument about the tectonic release problem, but I feel in the last year, and in one of their [DARPA] reports, that some very strong views and statements were made about being able to handle the problem of tectonic release. I don't think that that is a major problem that we now face.

Dr. **Mansfield**. Other people apparently do?

Dr. **Sykes**. I am not aware that people think we cannot correct effectively for this tectonic release.

Dr. **Mansfield**. So you don't know of anybody that disagrees with your position that you can solve the tectonic problems for Shagan River?

Dr. **Sykes**. I think the evidence there is quite overwhelming, of now having a consensus. Whether it is complete unanimity, I doubt that.

Dr. **Mansfield**. The DARPA panel essentially said that you could not count on it. That is why I am asking the question. My recollection is that the DARPA panel says you can't use that data because it was impossible.

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Dr. Sykes. That was sometime ago. They have come to some different conclusions there. I think in that matter it would be best to consult the classified document.

Dr. Mansfield. The Soviet tests at Kazakhstan since 1976, the average estimates of their yield, you have been quite strong in your written testimony both before us and before the Foreign Affairs Committree that you don't believe that the seismic evidence indicates that the Soviets have violated the treaty by going over 150 kilotons. Yet if I apply the yield estimation formula from our paper, using the .35 bias, I find that it looks pretty much like they did. In fact, it looks like by your calculations using .35 bias, 150 kilotons would be a magnitude of 6.14. I certainly see a lot of corrective magnitude published since 1976 about 6.14.

The only one I was able to put my hands on recently was the Federation of American Scientists paper of March 1984, of which you are on the board of directors, if I am not mistaken. I am going to assume you heard about this. That shows for the Kazakhstan site that there are six or seven tests above 6.14 or 1.5 since 1978. I know of no seismic data that disagrees with that, that there have not been a significant number of tests of magnitude 6.14 at Shagan River since the Threshold Test Ban Treaty went into effect in 1976.

My question then is simple, doesn't your method then allow me to conclude that at least the central values of these have been in violation?

Dr. Sykes. We have not only the data from the P-waves, but also from surface waves and yet a third method that has come on much stronger in the last 2 years, certain other types of waves by the name of Lg. So we may find that, for example, suppose the Soviets test 10 weapons at 150 kilotons, we expect, given the scatter in making observations, that some numbers will come out a little bit above, some will come out below, some will come right on.

I find it very interesting that if you take some of those that come up above and many of those that come a little bit above, for the P-waves, that they come under for the surface waves, which would be consistent with the fact that they are doing a lot of tests very close to that limit and that one technique with its scatter indicates something over, but other techniques indicate they are below.

Dr. Mansfield. The spread of magnitudes that I see from these is quite large. It is a spread in yield easily of a factor of 1.5 to 2.

Dr. Sykes. I think that if you go over that carefully that I don't believe that there is any substance then that we are talking about variations that are as large as that. It certainly can be argued whether though central values are in fact 150 or if they are 175 or 130. We can certainly clearly argue that they are not 200 or 250 kilotons.

Dr. Mansfield. I see a number that are at least more than one tenth of a magnitude, certainly 25 percent. But you have stated on a number of occasions, most recently to the Committee on Foreign Affairs, that you believe that external seismic networks are capable of monitoring Soviet test yields down to a precision of about 30 percent.

Dr. Sykes. So we are talking about a tenth of a magnitude unit there.

Dr. **Mansfield**. We have also heard in previous years that on-site inspection use is only capable of about 30 percent. You mean you are getting nothing better from external seismic network than you get from on-site?

Dr. **Sykes**. Well, I am not sure about that, but you do get another technique so you could average that, and even if it is only as good as 30 percent, but I think a big advance here has been using not just one wave but employing all three of these wave types as a way of reducing that error.

Dr. **Mansfield**. You missed my question. The on-site monitoring with hydrodynamic means, according to the testimony this committee has heard, is only capable of 30-percent accuracy. I find it difficult to believe that teleseismic means would be capable of equal accuracy.

Mrs. **Byron**. What is your afternoon timeframe? We have to reconvene at 1:30. I have a 12 o'clock appointment in my office. Could you come back this afternoon or are you scheduled to depart?

Dr. **Sykes**. I think I have a 4 o'clock departure.

Mrs. **Byron**. Could you come back this afternoon?

Dr. **Sykes**. Sure.

Mrs. **Byron**. Say about 1:30?

Dr. **Sykes**. All right.

Mrs. **Byron**. I think we have a few more technical questions and I want to get them on the record. At the same time the morning has been drawing on.

Mr. **Colby**. Could I add one phrase to my answer to Mr. Courter?

Mrs. **Byron**. You certainly may.

Mr. **Colby**. I will just take a second with respect to the danger of their developing a tactical nuclear small yield weapon secretly, and having it for their forces. The point is again that you are talking about depots, you are talking about construction facilities, you are talking of units capable of handling such weapons. All of these things have significance when you are making a judgment about their compliance. We have quite a good estimate of the total number of Soviet tanks. Tanks are inherently concealable, yet by combining all of our information, we can get a perfectly adequate estimate of the number of Soviet tanks we have to face. The Defense Department puts it out in booklets.

So the idea of their developing a weapons system into operational status, as Khrushchev tried in Cuba, I just find is not going to happen, and it certainly hasn't happened since Sputnik. We just caught the Cuban one by luck, but our machinery now is much superior to that and it is going to get even better as time goes on. So I think that danger is not a real one, with due respect.

Mrs. **Byron**. Let me say that our afternoon witness is due to start testimony at 1:30. He has to leave by 2:30. So to avoid having you sit and wait, suppose you would come back about 20 after 2?

Dr. **Sykes**. Fine.

Mrs. **Byron**. I can assure you it will be just about another 15 or 20 minutes. Come back about 2:15. That will be fine.

Thank you very much, Mr. Colby.

The panel is recessed until 1:30.

[Whereupon, at 12:30 p.m., the panel was recessed until 1:30 p.m., the afternoon of the same day.]

## AFTERNOON SESSION

Mrs. **BYRON**. When the panel adjourned earlier today, I had asked Dr. Sykes to return during the afternoon session for the purpose of responding to questions on technical matters.

He will follow our regularly scheduled witness, Dr. Kosta Tsipis, director of the Program in Science and Technology for International Security at the Massachusetts Institute of Technology.

I understand that Dr. Tsipis must leave at approximately 2:30 p.m. to meet his transportation schedule.

Welcome to the panel, Dr. Tsipis. I understand you have a prepared statement and you may proceed anytime you are ready.

## STATEMENT OF DR. KOSTA TSIPIS, DIRECTOR, PROGRAM IN SCIENCE AND TECHNOLOGY FOR INTERNATIONAL SECURITY, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Dr. **TSIPIS**. Thank you.

I am very grateful for you inviting me to speak with you today. I will have a prepared statement of about 10 or 12 minutes, so we can have a lot of time for questions which I hope we go no more than 2:30.

Members of the Armed Services Committee of the U.S. House of Representatives hardly need introduction to the nature of weapons. Yet, I would like to comment very briefly on the definition of weapons as an introduction to what I want to say to you today.

A weapon is an instrument for winning. By accumulating weapons it can use skillfully, a country can win in war, if war should occur.

By improving the efficiency of its weapons and increasing their number, a country can make winning more likely. Such is the nature of weapons.

Today, neither the United States nor its chief adversary, the Soviet Union, could win a war against the other with the 25,000 nuclear explosives each has amassed.

Increasing numbers and improving efficiency does not change this fact. There can be no winner in a nuclear exchange. If these explosives can never lead to winning, then they are not weapons.

If they are not weapons, then what are these 50,000 nuclear warheads? They are devices with which the Soviet Union and the U.S. deter each other from a planned war.

Deterrence, however, is a state of mind. It has to do with how opponents perceive one another.

We have been amassing nuclear explosives in order to effect a state of mind, lest we be perceived as irresolute or weak.

The Soviets, in turn, have mirrored our fears, accumulating over the years an equal number of nuclear explosives so that they will not be perceived as weak or militarily incompetent.

We both know that nuclear explosives are not weapons since their use cannot bring victory. We both know that using even a small number would spell the doom of both nations and more. We even know that even a small fraction of our arsenals suffices to intimidate the other nation.

Yet, neither nation dares stop accumulating these militarily useless explosives.

The fear of being perceived as weak or vulnerable, mirrored back and forth between the two nations, has propelled both the United States and the Soviet Union into an endless nuclear competition.

At first this competition was quantitative, in terms of numbers, but more recently the arms race has shifted toward qualitative competition.

This competition, if left to run its course uncontrolled, can go on essentially indefinitely.

This endless accumulation of ever-more-sophisticated delivery systems for nuclear explosives, which may have perceptual significance but are devoid of actual military utility, is both too dangerous and too expensive to leave untrammelled.

But it is my belief that we cannot arrest this foolish one-upmanship unilaterally. Instead, we must seek to establish mutually agreed upon, bilateral, verifiable restrictions that will permit the two nations to cease competing in the development of nuclear explosives and delivery systems without fearing that such cessation will be interpreted by the other as a sign of weakness or irresoluteness.

Since the main dimension of the current nuclear competition is qualitative, having to do with refinements in the technology and improvements in performance, I believe that the most effective way to dampen this competition is not to talk about numbers but to restrict activities to qualitative improvements.

I would like to propose two immediate steps to take in order to accomplish this goal, two different test bans to be agreed upon by the United States and the Soviet Union.

One is a complete ban on the testing of nuclear explosives—the warheads—and the other is a ban on the flight testing of ballistic missiles—the delivery vehicles.

I would argue that these two limitations will have three desirable effects.

They will alter the existing strategic balance in favor of the United States; will enhance strategic ability; and will abruptly check the nuclear race.

To take a complete test ban first, a complete ban of nuclear- explosives testing, including the underground testing now permitted under the Limited Test Ban Treaty, will freeze in perpetuity the current U.S. advantage in yield-to-weight ratio of nuclear warheads.

It will strengthen our hand in efforts to prevent the horizontal proliferation of nuclear explosives technology to additional countries, and it will remove the often parochially motivated claim that the United States must continue developing more refined types of nuclear explosives lest we be perceived as negligent.

There have been four arguments raised against a complete test ban.

One, that such a ban would not be verifiable.

Two, that confidence in the reliability of our store of nuclear explosives will erode without testing.

Three, that new designs of nuclear explosives and more particularly the nuclear-powered x-ray laser require freedom to test.

And four, that Los Alamos and Lawrence Livermore National Laboratories, which are responsible for the development of nuclear explosives, will disband if prevented from testing new nuclear devices, and the country will lose the precious resource of the specialized group of scientific and engineering talent now assembled at these laboratories.

None of these objections to a complete nuclear explosives test ban is valid.

## VERIFICATION

As Professor Sykes told you this morning, a combination of new seismic methods, the development of tamper-proof unmanned monitoring stations by Sandia National Laboratory, and the willingness of the Soviet Union to accept an adequate number of such stations in its territory give us great confidence that such a ban can be monitored very reliably, down to explosions with energy yields of 1 kiloton or less.

There is general agreement that there is no imaginable military utility in nuclear explosives of such small yield, especially for the Soviet Union, which now possesses about 25,000 explosives of vastly greater yield.

## RELIABILITY

Most of our inventory of nuclear explosives has been designed to remain quite reliable for indefinite periods of time given proper maintenance and replacement of certain components at prescribed time intervals.

More recent designs may be more sensitive to deterioration of certain materials or components, but again, with proper maintenance and what is known in the trade as "zero yield test," the certainty that these recent models, too, will explode when detonated can be confidently maintained.

## NEW DESIGNS

Improvements in the yield-to-weight ratio of nuclear explosives have reached the point of diminishing returns in the United States.

We have, so to speak, squeezed the last drops of energy out of the nucleus. In recognition of this fact, the nuclear laboratories have concentrated their efforts on developing nuclear explosives that release their energy in predominantly one form or another. The neutron bomb and the so-called x-ray laser are examples of such efforts.

I would like to take a moment to comment on the x-ray laser. This laser, which attempts to bunch a small fraction of the x rays released by a nuclear detonation into a concentrated beam, has been mentioned as a possible component of a space-borne antiballistic missile system.

President Reagan has since stated that the defense he envisions must be exclusively nonnuclear, which eliminates this nuclear bomb-powered device.

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But, in fact, x-ray lasers would be unsuitable for such use in any case, since there already exists effective countermeasures against them and since their nuclear detonations would unavoidably harm the other space-based components of such a defensive shield.

Furthermore, the designs now being considered are millions of times less powerful than would be needed. The conclusion is inescapable that the x-ray laser is useless as a weapon and should not be allowed to impede the establishment of a ban on all nuclear explosives tests.

### THE LABORATORIES

Finally, even in the absence of a complete test ban, I believe that the technical ingenuity and expertise resident in Los Alamos and Livermore Laboratories would be better directed toward developing new conventional weapons that would be useful in combat, true instruments for winning a war.

Development of conventional armaments has been relegated to second place in this country. As a result, we have the Sergeant York antiaircraft gun and a host of other fearfully expensive but flawed systems.

The resident expertise and organization of our nuclear laboratories is too valuable to waste on useless nuclear devices.

It can and must be used to improve our conventional weapons, thus achieving two goals: Maintaining the vitality of the laboratories and strengthening our ability to win in war.

I turn now to my second proposal, a mutual ban of ballistic missile tests by the United States and the Soviet Union.

Such a ban will primarily affect the accuracy and reliability of the delivery vehicles, which require constant testing for both maintenance and improvement.

A flight test ban will put an end to the development of ever more accurate ballistic delivery systems and will also erode confidence among Soviet military planners that their existing ballistic missiles will maintain the very high degree of reliability required for a surprise countersilo attack.

Thus, such a ban will not only preclude any further increase of the threat against our land-based missiles, but will also gradually erode whatever threat may exist today.

President Reagan has repeatedly stated that the most dangerous component of the Soviet nuclear arsenal is their very accurate land-based ballistic missiles. To counter this threat, he has supported building the MX. By preventing any further improvement of ballistic delivery systems and ensuring the erosion of the current performance level, a missile flight test ban will provide the security for our land-based ballistic missiles that we have been trying to achieve by contemplating mobile basing for the MX, for example, or by developing an antiballistic missile system.

Rather than spend hundreds of billions of dollars for such systems, we can ban the flight testing of ballistic missiles and achieve equal, or better, security.

Such a test ban would be additionally advantageous for the United States in that, like a complete nuclear explosives test ban, a flight test ban would leave us ahead in some important areas of technology.

The United States has already tested a re-entry vehicle that maneuvers to evade antiballistic missile defenses, while the Soviet Union has tested no such devices.

Therefore, a missile flight test ban will freeze us into a position of superiority. Since the United States is also decisively ahead of the Soviet Union in stealth technology, the testing of which is not affected by a missile flight test ban, a ban on ballistic missile testing will blunt Soviet advances in the delivery technology on which they are most dependent, while leaving the United States free to apply stealth in its next generation of bombers and cruise missiles.

Finally, a test ban on ballistic missiles will improve strategic stability by reducing the probability that the Soviet Union will ever contemplate a surprise attack against United States missile silos and command centers.

Such an attack requires both very high accuracy and very high reliability, performance characteristics that can be achieved only by frequent and continuing testing of ballistic missiles.

There is one reason that we might not want to put a complete missile test ban into effect immediately. We and the Soviet Union might want to continue development of small, single-warhead missiles that can replace the destabilizing, 10-warhead MIRV'd missiles.

In that case, we could nonetheless enact an immediate ban on testing all multiple-warhead-capable missiles until the agreed development of the smaller missiles was complete.

A great advantage of a missile flight test ban is verifiability. There is a general agreement that such a ban, whether partial or complete, can be monitored with very high confidence.

A ballistic missile test is a highly visible event, and the reentry stage, which is the crucial portion of the test, cannot be concealed or spoofed.

On the negative side, it is true that our confidence in the accuracy and reliability of our ballistic missiles will gradually decrease.

But the mission of the U.S. nuclear forces is to maintain the capability for a second strike. We will assuredly retain this deterrent capability, since the nature of the targets of a retaliatory strike does not require high accuracy, and since a second strike, unlike a first strike, does not require that every target be destroyed.

For the past four decades, we have accumulated nuclear explosives on increasingly sophisticated delivery systems in an attempt to improve our security.

The result has been exactly the opposite. Our security has deteriorated. This is not an unavoidable condition. Deterrence does not require escalation, either quantitative or qualitative.

It is quite stable at a static level that is much, much lower than our present inventory. And since nuclear devices are not weapons and can never help us win in war, there is no reason to accumulate them in peacetime.

The competition to amass nuclear explosives has escalated the danger to our security and the draining of our resources, for these devices are not only useless and dangerous, they are also, as you members of the committee well know, expensive.

Imagine what our Nation will be like 10 years, 50 years from now if we allow this mindless accumulation to continue.

As a starting point to stopping it, I urge you to support agreements with the Soviet Union to ban all tests of nuclear explosives and all flight tests of ballistic missiles.

I am grateful for the opportunity to address the committee. Thank you.

Mrs. **Byron**. Thank you, Dr. Tsipis.

Let me pursue a couple areas that you touched on.

You say that efforts should be made to restrict quantitative improvements. Why wouldn't either side simply go to the weapons of a larger megatonnage, as was the case in the 1960's, to make up for the uncertainties due to the lack of testing?

Dr. **Tsipis**. Because increasing the yield of the weapon only marginally increases its ability to destroy a silo.

If you increase the yield of a weapon by 10 times, its ability to destroy a silo increases only about two and a half times.

If you increase the accuracy of a weapon by 10 times, the ability of destroying a silo increases by 100 times.

So, what you have here is a technological situation in which it does not pay to increase yield because you can always defeat that by strengthening your silos.

So, it is accuracy that, as we all know, threatens silos and not necessarily yield.

Mrs. **Byron**. Are you familiar with any treaty which has halted the technological progress in weaponry because of the fact that the treaty has been signed?

Do you really feel a treaty whose verification is in question will stop the technology from going forward?

Dr. **Tsipis**. Well, first, I do not believe that the verification is an issue.

Second, we did have treaties that banned entire areas of technology, fractional orbital bombardment systems for example or the entire ABM technology that we decided to ban in 1972.

I am very confident that if you ban underground testing, then the further improvement of nuclear explosives will be stopped. That is an advantageous thing for us because the Soviets, I understand, still have designs of their weapons from the 1960's.

They have not done much better. Banning ballistic missile testing will remove the threat that we are now fearing about our silos, in the sense that both the accuracy and the reliability of their missiles will erode undoubtedly.

Since we are not planning a first strike, they are planning a first strike, we would be better off.

Mrs. **Byron**. During the 1958–1962 moratorium timeframe, do you feel that we encountered problems with our weapon design during that period, since we were not permitted to do any testing, fairly extensive problems that arose?

Dr. **Tsipis**. I believe that there is congressional testimony from laboratory directors that at that time there was no serious question as to the reliability of our weapons.

The weapons that were designed earlier on were very, very reliable. More recent designs are much more finicky, if you please, and require more testing, but even those can be changed.

Mrs. **Byron**. It is my understanding that we had a problem with the Polaris warhead, the first Poseidon warhead, the Minuteman warhead, during that period of time.

Dr. **Tsipis**. The problem with the Polaris and Poseidon was not in the warhead; it was in the electronics that triggered the warhead and also the electronics of the missile itself.

These were tested. These problems were discovered during the development of these warheads in their original testing, and I believe—I am not very sure about this—but I believe that once these changes were made, the warheads proved to be quite reliable.

Mrs. **Byron**. Didn't they all have to be tested in a total configuration?

Dr. **Tsipis**. That I do not know. There was extensive testing of these things during their development and initial deployment, as we do with all weapons.

Mrs. **Byron**. Mrs. Holt, do you have any questions?

Mrs. **Holt**. I have no questions.

Mrs. **Byron**. Mr. Mavroules, do you have any questions?

Mr. **Mavroules**. Yes, I have, Madam Chairman.

I have one question. First I want to thank Dr. Tsipis for his presence here today.

It is very meaningful and we appreciate it very much.

Dr. **Tsipis**. Thank you.

Mr. **Mavroules**. I don't want to get into the technical parts. I want generally to ask you some questions and perhaps you can respond to it.

I ask the question with tongue-in-cheek because this kind of testimony comes before the full committee when we have people from the Pentagon come forth. Then we have personalities like yours come forth, and we just can't put it together.

In your opinion, your judgment, how strong is the United States today relative to our national security with what we have; also, what we are contemplating for the future versus the Soviet Union—what they are contemplating in their sixth generation of nuclear weapons. I believe ours is the third. I am not talking about the modernization of conventional systems. I am talking strictly strategic and nuclear systems.

We have to have, at least in my opinion, some kind of an arms control agreement. We have to get this insane policy going the other way.

The argument comes forth that if we do not have an excellent test ban treaty, then it is going to be a disadvantage to the United States.

We have the other argument, that if we don't build the MX missiles while the Soviet Union has those big ones, they can knock us out.

If we don't build the Trident-II or D-5, then the Soviet Union has something that will knock us out. Can you give to me and to the committee your view as to how you see the strength of the United States today?

### U.S. STRENGTH TODAY

Dr. **Tsipis**. Well, to begin with, I do not believe that any kind of use of nuclear explosives can at this stage of the game knock one out and not the other.

Therefore, I believe that using nuclear explosives will be suicidal rather than strategic war planning policy.

There is no way with all these warheads we now have, in the United States and in the Soviet Union, that one country, even by a first surprise attack, can disarm the other, and since it takes only a few hundred such weapons to devastate either country, it is mathematically certain that an exchange of nuclear weapons, if allowed to escalate, will quickly doom both countries to defeat.

So, there is no such thing as comparing strength on the basis of strategic systems. We both have enough to deter each other. We have more than enough to deter each other, and further refinements do not increase or decrease this deterrence.

They increase or decrease some of our fears, some of the Soviet fear, and as you have seen, the emergence of the very large, very accurate Soviet missiles have increased our fear that some of our silos may be vulnerable.

The planned development and deployment of the D-5 has raised fears in the Soviet Union that their silos, which contain 75 percent of their nuclear arsenal, will be vulnerable to our submarines.

So, we are trading in fears here. We are not trading in actual military realities. And I believe that the answer to your question is that the present number of explosives that we have, and with the present kinds of deployments, it doesn't matter exactly how many we have in exactly what kind of configuration.

We cannot use these objects to win. We cannot. The Soviet Union cannot use it to defeat us because they will also be destroyed.

Therefore, I don't see what the entire competition is all about.

I am sorry you left the conventional weapons out, because I think that there is where the severe difficulties that we are facing are.

Mr. **Mavroules**. Would you care to address that?

Dr. **Tsipis**. Well, I believe that we have neglected our conventional weapons. Many of you, I am sure, have gone over to Europe and talked to our NATO officers, to General Rogers, who will tell you of the grave difficulties we have in terms of conventional weapons, their numbers, their performance, our preparation, our training, our maintenance, our stores, our plans for transporting material and troops over in Europe quickly.

There is where it seems to me our real difficulties lie, and there is where we should be focusing our attention.

Mr. **Mavroules**. I appreciate that very much. I do have one final question, if I may be allowed to ask it.

The comprehensive test ban treaty, in your judgment—I have not had a chance to read your testimony—would that be beneficial to the United States and to the Soviet Union relative to peaceful motives for the future, or would it discredit our defense security and the integrity of this country?

Dr. **Tsipis**. If it is mutual. That is what we are talking about.

Mr. **Mavroules**. Of course, mutual and verifiable.

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Dr. **Tsipis**. That would not be discrediting because both would stop. There would be no fear that we would be perceived as not being concerned enough or interested enough in our defense.

Therefore, a comprehensive test ban treaty would allow us not to test without fear of being perceived as indifferent or weak or irresolute.

It will improve our position in the sense that we won't have to worry about further improvements in the Soviet warheads.

The yield-to-weight ratio of Soviet warheads is not nearly as good as ours.

Our scientists have either spent more time or are brighter or we have better, faster computers, and as a result, the yield-to-weight ratio is very, very high.

They are almost miniaturized. Therefore, if we have no more testing that superiority, whatever it means, is frozen to our advantage.

Third, we have the nonproliferations treaty in which we promised the rest of the world to dampen our nuclear arsenals, to try to cut them down, so we can convince the rest of the world not to devise their own nuclear explosives.

Fears about a country using nuclear weapons or nuclear explosives seems to me to be much more realistic coming from third countries rather than from the Soviet Union or from China.

I would worry more about Brazil or some crazy dictator somewhere launching or introducing into this country nuclear weapons rather than the Soviet Union.

Mr. **Mavroules**. I appreciate your response. Thank you.

Mrs. **Byron**. Mr. Courter.

Mr. **Courter**. Thank you very much, Dr. Tsipis. I enjoyed your testimony.

Dr. **Tsipis**. Thank you, sir.

Mr. **Courter**. You come down on the side, obviously, of a comprehensive test ban, No. 1, and on the detonation of nuclear warheads, and also a comprehensive test ban on the deployment or testing of launch vehicles.

I asked this question of this morning's witnesses. I think they were quite specific. At the present time, the Soviet Union does have peaceful nuclear explosions.

As a matter of fact, there is a peaceful nuclear explosion treaty that has not been ratified by the United States permitting peaceful nuclear explosions.

In view of the fact that it is extremely difficult with any high degree of confidence to know whether a peaceful nuclear explosion is done solely for civilian purposes, would your argument be such that for a comprehensive military nuclear explosions treaty to be worthwhile, that it would have to include and embrace a comprehensive test ban of peaceful nuclear explosions, as well?

### PEACEFUL NUCLEAR EXPLOSION TREATY

Dr. **Tsipis**. This precise subject has been discussed extensively among American and Soviet scientists.

It is, indeed, true that a so-called peaceful nuclear explosion can hide the test of a nuclear device that could be used in a delivery system.

Peaceful nuclear explosions in the Soviet Union have planned to be used in civilian tasks like digging canals or ports. I believe that they have given that idea up to begin with because they recognize how costly it would be in terms of real estate, how much they have to give up in terms of land to do that.

No. 2, the solution we had—there is a solution for that—is that if the Soviet Union requires a peaceful nuclear explosion, we would provide it, and if we require a peaceful nuclear explosion, they will provide that.

That clearly obviates any point of cheating.

Mr. Mavroules. So, your position is, in order for a comprehensive military test ban to work, you have to, as well, have a prohibition against civilian nuclear tests.

Dr. Tsipis. We need a prohibition against their own peaceful nuclear explosions.

Mr. Mavroules. We would test their civilians and they would test ours.

Dr. Tsipis. We would provide them with an explosive to do their task and they would provide us with an explosive to do our task. Since we are not going to do that, I think it is a moot question.

Mr. Mavroules. So, therefore, unless you have that type of arrangement, it makes no sense in entering into a comprehensive test ban?

Dr. Tsipis. Given the experience we have had with the Soviets, I would insist upon such an arrangement.

Mr. Mavroules. It makes no sense to have a comprehensive test ban unless you have that type of arrangement with the Soviet Union.

Dr. Tsipis. That would be true. I believe such arrangements informally have been agreed upon.

Mr. Mavroules. The answer is yes?

Dr. Tsipis. Yes.

Mr. Mavroules. Second, with respect to the ban on testing.

Dr. Tsipis. Ballistic missile testing?

Mr. Mavroules. Yes, launches of the launcher itself—can a lot of information, militarily useful information, be gathered, once again, from a launcher for a satellite, the launch for satellite, the launch for civilian purposes, payloads for photographic reconnaissance or experimentation, civilian experimentation, civilian experimentation in space, et cetera, et cetera.

Can not lift capabilities, thrust, thrust to delivery vehicle ratios, be all monitored in a civilian test and then the information given to the military?

Dr. Tsipis. All that would be true. You may have a new launcher that has better thrust. It has better performance. It is bigger.

On the other hand, the crucial stages of a ballistic missile that carries nuclear explosives are two. One is the actual positioning of the warhead as it leaves the MIRV'ing process and the second and most crucial is reentry, because it is in reentry that the warhead is subjected to the rather stringent and harsh, thermal and mechanical stresses.

Therefore, unless you test reentry, you are not really testing a new weapon. You may test a new launcher, but it seems to me no military officer who wants to have confidence in such a weapon would ever accept a ballistic missile with a nuclear explosive without actually testing both the MIRV'ing stage and the reentry stage.

It is this that gives us confidence that once you stop and you can reliably monitor the testing of a ballistic missile, both MIRV'ing and reentry, then essentially, you have stopped the development of such weapons.

Mr. **Courter**. You start out in your testimony with the premise, and on one level I agree with you, on one level I certainly do not, that there is no such thing as a nuclear weapon because it is irrational to use it, what you cannot really use cannot be a weapon. That philosophy perhaps can be defended, but practically I am not sure that it can.

But the point that I would like to make is that I am not so sure whether increasing accuracy is bad, and my point is looking at the history of the development of nuclear weapons, ICBM's, SLBM's, they were pretty sloppy vehicles in the beginning, crude in the sense that they were not very accurate. In order to achieve a military goal and because of their inaccuracies, the yields had to be very big, up to 20 megatons, as a matter of fact, keeping in mind that the atomic bomb dropped on Hiroshima was 12.5 kilotons. So you are talking of a really big explosion.

The yields have been coming down, not because of treaty, particularly but they have been coming down in the United States quite dramatically because of the increase in accuracy.

You described that very well just a few moments ago. Could an argument be made that any type of a treaty that would prohibit the increased accuracy of a weapon is going to freeze into place large nuclear warheads of the size that the Soviet Union has today and that if the Soviet Union increases their accuracy, we increase our accuracy, as a matter of fact, most of the military goals of that type of weapon could be achieved by conventional explosives and not nuclear explosives, and that attempting to prohibit accuracy prohibits a desirable trend?

Dr. **Tsipis**. Well, I am not quite sure I agree with everything you say.

Mr. **Courter**. I know you do not.

Dr. **Tsipis**. Let me try to take it one at a time. I believe that the yield of weapons decreased as we fractionated.

Mr. **Courter**. Decreased?

Dr. **Tsipis**. Yes. We went to smaller warheads because we wanted to MIRV. That required a price. You had to pay a penalty. You had to make smaller warheads in order to put many on one MIRV. The same thing happened with the Soviet Union. They went from a megaton and a half to half a megaton, things like that, on their reentry vehicles.

So I believe that if they had a way to maintain their yields and improve their accuracy, they would have done precisely that.

Mr. **Courter**. We did not do that though. We have reduced unilaterally without the benefit of treaty the yield on our strategic arsenal because our accuracy improved. I am just wondering whether you want to create an environment in this world where accuracy is not improved, thus perpetuating large yield warheads.

Dr. Tsipis. Let me go back to your statement. I believe that we deliberately, as you very well say, reduced the yield of our weapons because we do not need it. Our strategy is a strategy of retaliation, which means that we do not need very high yield and very high accuracy. Our targets are mainly soft targets, second strike targets.

Mr. Courter. I disagree with that.

Dr. Tsipis. Would you like——

Mr. Courter. I know what our targets are.

Dr. Tsipis. Well, are you then saying that the United States strategic policy is first strike?

Mr. Courter. No.

Dr. Tsipis. If it is not a first strike——

Mr. Courter. It is to deter a first strike.

Dr. Tsipis. Well, if it is to deter a first strike——

Mr. Courter. If our policy was to destroy soft targets, what we would want would be large warheads of 1 megaton and over.

Dr. Tsipis. No. It would be small warheads we can spread around, spread the energy more evenly; it is more efficient. Let us think of a scenario in which while we are maintaining a deterrent policy we would like to be able to attack Soviet silos. If our policy is one of deterrence of a second strike, then by definition they are going to launch their missiles first.

Now, there are two possibilities: either they launch all their missiles and then all their silos are empty or they launch a fraction of their missiles and keep a reserve. But now, since they have launched a fraction of the missiles, we are on war footing; therefore, their forces are on high alert and the moment they see our first ballistic missiles above the horizon, they are going to launch the rest of their missiles.

So I see no way in which we could possibly ever attack missiles in their silos in the Soviet Union.

Mr. Courter. You think we would attack their populations?

Dr. Tsipis. I think that is a false dilemma. We have either silos or the populations and thousands of military targets in between which are soft targets.

Mr. Courter. I think what we want to do is attack their command and control centers which are hardened, which are often deep and underground. That is why we want accurate warheads.

Dr. Tsipis. Are you postulating——

Mr. Courter. That will deter the first strike and deter a second strike.

Dr. Tsipis. Are you then postulating a decapitation strike?

Mr. Courter. As a second strike?

Dr. Tsipis. As a second strike.

Mr. Courter. As a threat to deter a first strike.

Dr. Tsipis. But command posts are not volatile targets; they can be attacked by bombers.

Mr. Courter. Let me—we could spend hours on this. Might not if you had a prohibition on the test of lauchers and obviously both sides——

Dr. Tsipis. Ballistic missiles?

Mr. Courter. Yes, and also a test of nuclear explosions so your confidence in the reliablity of your present strategic inventories would gradually go down. It would be, I think, a desire of both sides to try to maintain the confidence in their military arsenals, whether you call them first strike or second strike or for the purpose of defense, whatever it might be. High confidence is something the United States wants and I imagine the Soviet Union wants. It is logical and rational to expect that.

If you entered into a treaty that degraded the possibility or the confidence level in your present inventory, would you not want to make up for that degredation in confidence by deploying more missiles so your level of confidence would stay the same? You follow what I am saying?

Dr. Tsipis. Indeed. Confidence is a relative concept. You would like to maintain your confidence in what you want to do, in what missions you have planned for yourself. The Soviet Union, which we assume has a mission to attack our missiles preemptively, must have very high confidence in the absolute performance of its systems. The United States, which has a second strike policy, must have confidence that we can fulfill that mission. The second strike policy mission involves attacking nonhardened targets, involves attacking military targets which are not going to run away and they are soft by and large. Therefore, we can maintain confidence in that mission because that does not require very high accuracy and very high reliability and also can be performed by atmospheric systems, cruise missiles, bombers, things like that.

So by eroding confidence in both arsenals we preclude the possibility the Soviet Union can fulfill its mission while we maintain our ability to perform our mission, which is the second strike.

Mr. Courter. Finally, wouldn't it be better under that scenario if we could defend some of our missiles?

Dr. Tsipis. It would be wonderful.

Mr. Courter. You are in favor of a point defense?

Dr. Tsipis. If what we need is a point defense of ballistic missiles, then we should decide to do so, plan to do so, develop and deploy such a defense.

Mr. Courter. So you are not against it.

Dr. Tsipis. But I believe that there are other cheaper ways to defend our missiles, to protect our missiles and I believe——

Mr. Courter. By hardening?

Dr. Tsipis. No; by dispersion, by mobility, by making them single warhead missiles. There is no advantage in attacking a single warhead missile. You lose two of your own to attack one of the other side. If we decide—if we decided that our national interest is to have point defenses, I think we should do so and the technology exists for that. But I want to remark that what we are talking about now has nothing to do with point defense.

Mr. Courter. A starting point.

Dr. Tsipis. And the problem with the strategic defense, in my mind, one of the problems is that the projects that were pursued by the Army in the past to develop point defense have been abandoned. I am sure if you look in the budget you will recognize that fact.

Mrs. Byron. Mr. Spratt.

Mr. **Spratt**. Thank you.

Thank you, Doctor, for your testimony.

Do I understand what you have just told Mr. Courter correctly to mean that you are proposing these two treaties, these two bans, these two cessations of testing, are linked together inseparately? Are you saying that a test ban treaty on warheads alone is not worth it unless it is accompanied by a testing cessation on new launchers?

Dr. **Tsipis**. The two proposed bans achieve different purposes. The complete test ban treaty that prohibits all testing of explosives will achieve the modest purpose of keeping us ahead in yield-to-weight ratio, improving our treaty and maintaining the kind of atmosphere in this country and abroad that says, yes, we are willing to do something about this endless improvement of nuclear weapons, but it is not going to improve our security substantially; it is not going to improve what I call strategic instability; namely, the fact that whoever strikes first may think to himself that he is going to have an advantage; and it is not going to improve our ability to perform the missions that we have assigned ourselves, while at the same time blocking the Soviets from performing the mission that we think they want.

So a complete ban on explosives has very modest results, but they are positive and do not cost us anything. A ban on ballistic missile testing would have much more importance and a much more advantageous outcome for us.

Mr. **Spratt**. You are not saying that, one, first, a ban of all nuclear explosives should be abandoned if the second cannot be also attained.

Dr. **Tsipis**. No; the two are not coupled. They are two different steps, two different measures; they have two different sets of results, some important and some more important.

Mr. **Spratt**. I want to make that clear.

We heard testimony this morning that the Threshhold Treaty has actually inhibited or impeded the Soviet Union in developing the full potential of their heavy throwweight missiles. Do you share that opinion?

Dr. **Tsipis**. In the sense that a Threshhold Treaty may have prohibited the Soviets from testing new nuclear devices with better yield-to-weight ratio for yields larger than 150 kilotons, that is true.

Mr. **Spratt**. I also read your testimony to indicate that you have some confidence in the Midgetman system. Not in passing technical judgment on it, but you do think if we have another system to move to in the near future certainly that should be one of our choices.

Are you suggesting that it should be considered. Midgetman, and something should be carved out of the treaty, some checks for Midgetman testing should be carved out of any treaty that is negotiated.

### MIDGETMAN TESTING

Dr. **Tsipis**. One of the strategies for increasing security and decreasing instability has been proposed, and that is an effort to remove MIRV'd missiles and replace them with single warhead missiles. Everybody agrees across the ocean and across the ideological spectrum in this country that improving the security of the country by reducing instability is a good thing; and everybody agrees that going to single warhead missiles would achieve that if we remove the MIRV'd missiles on both sides. Because of that, I believe that serious consideration should be given to the idea of developing a single warhead missile and replace all our missiles, both here and in the Soviet Union, with single warheads, maintaining the number of launchers, but making all these launchers single warhead. That will have two effects: No 1, it will obviate any thought of a preemptive strike because you will have to use two to kill one of the others. Why would you ever do that? And, No. 2, reduce the number of nuclear explosives by a factor of 10.

Now we have 2,000 launchers overall and we have almost 9,000 warheads on each side. If you go to single warhead missiles, you can have 2,000 launchers and 2,000 warheads on each side, a much more stable situation, much lower numbers, while deterrence still obtains.

Mr. **Courter**. An interesting point and, in fact, it is one of my points. I think you should go to single warhead, less attractive targets. The question is, under a freeze, under a ban of testing of launchers, how can you test a single warhead missle?

Dr. **Tsipis**. That is precisely why I have suggested that we exclude single warhead missile testing so that we can finish that development and then we go to a compiete test. My proposal here is to ban initially only ballistic missile tests of MIRV'd missiles and then once we finish our deployment and development of single warhead missiles, then we go to the complete ban.

Mr. **Spratt**. I have no further questions.

Mrs. **Byron**. Mrs. Holt, do you have any questions?

Mrs. **Holt**. No.

Mrs. **Byron**. Mr. Klein.

Mr. **Klein**. No.

Mrs. **Byron**. Dr. Mansfield, do you have any questions?

Dr. **Mansfield**. Your argument assumes that the qualitative competition that you mentioned on page 2 will equally lead to nuclear weapons, that are not weapons. You assume that the result of qualitative competition are devices which will not be militarily usable. Why should I believe that?

Dr. **Tsipis**. Why should you not believe it? Give me a scenario in which nuclear devices become useful if accurate.

Dr. **Mansfield**. I didn't say very accurate, I said as a result of qualitative competition. For instance, the third generation nuclear, your argument doesn't prove that third generation directed energy are militarily useless or nonweapons through the use of which there can be no winner and things of that argument.

Dr. **Tsipis**. Third generation nuclear weapons remain nuclear weapons. The neutron bomb is a 10-kiloton weapon. I very much doubt whether an opponent, No. 1, will agree to use only third generation weapons, and second, whether he will make a distinction if he sees a third generation weapon being used and not use——

Dr. **Mansfield**. Then what is the purpose of constraining if the competition is not bad and doesn't lead to anything that is going to

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be used in any particular way? Why do you want to constrain the competition?

Dr. Tsipis. It is wasteful and dangerous because it accumulates additional useless devices. There is no third generation weapon that I know of, and I studied them rather carefully, that have any military utility, neither the x-ray laser nor the neutron bomb, nor the EMP-tailored weapon, have any conceivable military utility.

Dr. Mansfield. Thank you.

Mrs. Byron. Dr. Tsipis, thank you very much for coming down and giving us the testimony. I think, as you can tell, it was very excellent. It piqued lots of interest on this side of the table.

Dr. Sykes, we left off this morning and I appreciate your giving us the time this afternoon to finish up on some of the questions. Mr. Mansfield has some technical questions that he wanted to finish.

Before we get to that, Mr. Spratt, did you have any further questions that you thought of for Dr. Sykes?

Mr. Spratt. I was going to ask one or two. One question, if I could follow up.

Mrs. Byron. Yes.

Mr. Spratt. A question I asked this morning, it was the data concerning the 500-kiloton warhead testing that the Soviets had in the midseventies. At that time they were developing their latest heavy throwweight missiles. Does that necessarily imply that they only, therefore, developed 500-kiloton warheads? What sort of range of kilotonnage, of yield, could you infer from that? Could they go from 500 to one megaton, for example?

Dr. Sykes. If we look at that testing profile from 1964 to 1976, we find that of the quite large weapons, more than half of them were 500 kilotons. Obviously, that is something very important. They got off three more tests in the 21 months that they had until the threshold treaty entered into force.

Mr. Spratt. But you conclude from the fact that there were quite a few 500-kiloton tests that they had an unusual amount of interest in a 500-kiloton warhead?

Dr. Sykes. That is right, and also that in those 21 months there were no tests between 75 and 500 kilotons for that period of time. It seemed to be something of relative nonimportance to them compared to getting off these 500-kiloton tests.

Mr. Spratt. Thank you.

Mrs. Byron. Mr. Klein.

Mr. Klein. Dr. Sykes, in line with Mr. Spratt's question here, I wanted to clear this up for the record and maybe you want to clear it up. I suppose you make no claim to being a weapons design expert or anything of that nature, but the fact that the Soviets, or the United States for that matter, have limited their testing to 150 kilotons does not mean that either or both of them have not, in fact, developed weapons in that megaton range during the time of the test ban or the Threshold Test Ban Treaty. In fact, if that is so, we have been flimflamed because we have paid a pretty chunk of money to develop something called the B83 bomb, which is considerably more than 150 kiloton yield. Do you want to address that?

Dr. Sykes. I think there are two points there, that of course there are weapons of 1,000 kilotons or megatons that exist.

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Mr. **Klein**. They have been developed during the Threshold Test Ban Treaty?

Dr. **Sykes**. I am talking about ones developed before that.

Mr. **Klein**. I was addressing ones developed during the threshold test ban.

Dr. **Sykes**. I wanted to make two points: That both countries have weapons developed some time ago that are 1,000 kilotons and presumably those can be used again if necessary. The point about whether there has been testing of weapons of that size since 1976, during the cross examination of Dr. Donald Kerr, the director of Los Alamos in the hearings May 8, he was asked what size test, for example, if you test somewhat above 150 kilotons, would become of greater military significance, and he indicated that it was a factor of two, that by testing at 150 kilotons weapons could be reliably developed up to about 300 kilotons but not larger than that. So I am taking his testimony of what he says about the factor of two, that by testing at 150 kilotons the Soviets cannot test new weapons of 500 or 1,000 kilotons.

Mr. **Klein**. You do not give the Soviets then the amount of expertise that we have, that much credit, that if we can do a 1 megaton bomb under the regime of the threshold test ban that then they cannot?

Dr. **Sykes**. Dr. Kerr's testimony would indicate that is not the case for the United States or for the Soviet Union, and he went on to talk about, for example, that if the Soviet Union were testing at around 300 or 400 kilotons, I am not sure of the exact number that he used, but substantially above the 150-kiloton limit of the Threshold Treaty, they might be able to develop a weapon of around a megaton for a single warhead missile like the SS-25 or a Midgetman-type system.

So he was concerned if they are cheating substantially, that they then could develop something that is two or three times larger that would be in the megaton class. But I am presuming that if, in fact, from his testimony they can only test at 150 as we have, that they will not be able to develop a megaton weapon.

Mr. **Klein**. The point I wanted to make is that you do not have to test at 300 or 500 kilotons to develop a weapon of 300 to 500 kilotons nor do you have to test at a megaton tc develop a weapon that will deliver a megaton explosion; so your testimony this morning tended to confuse that point, and I just wanted to clear it up for the record.

Dr. **Sykes**. That is in the published testimony for House Joint Resolution 3 of last May. He made some rather definitive statements about that point, and he is head of one of the weapons labs, so I think that that requires more elaboration on his part.

Mrs. **Byron**. Mr. Mansfield.

Dr. **Mansfield**. We ended this morning in eastern Kazakhstan. When we finished this morning's discussion, it—I had asked you whether the application of the yield to magnitude correlation with a bias of 0.35 truly did result in there being at least six tests since 1976 at eastern Kazakhstan in excess of 150 kilotons. You mentioned that use of other data such as surface waves or Lg would take care of reducing those and there was general consensus that that was the case.

Do you think it was misleading of the U.S. Government to have pointed out the large increase in the number of high-yield tests in eastern Kazakhstan following 1976 as pointed out in the Federation of American Scientists article that I quoted this morning?

### SOVIET TESTING

Dr. **Sykes.** I think it is important to keep in mind the whole profile of Soviet testing, that the Soviets like the United States for very large tests had to go to a very remote site. So they did all their very large testing prior to 1976 at their Arctic test site and nothing larger than 150 kilotons prior to that time in eastern Kazakhstan. Before the Threshold Treaty there was a 2-year period in which they did not do tests that were anything like 150 kilotons at eastern Kazakhstan and for another 2 years until 1979 they conducted tests of around 75 kilotons, but only in the summer of 1979 went up to about 150 kilotons by my reckoning, and they have tested a number of explosions since that time of that size.

I have tried the example of taking away the dates and asking someone with reliable estimates of the sizes of those explosions, of the magnitudes, not getting into the controversy about the bias and yield estimation, to pick one time on here as is alleged the Soviets made one big jump in the increase of the size of their tests. You will find there are about three different jumps that they made between the time the treaty was signed and went into force in 1976 and June 1979, so there is not just one step there.

Dr. **Mansfield.** Do you suggest that the reason for this gradual increase in testing was to get a handle on how large the ground motion would be from large underground testing?

Dr. **Sykes.** We suggest that is one possibility. Remember that they went from testing things that were 150 kilotons and larger at their Arctic test site and they had conducted only two tests at eastern Kazakhstan of 150 kilotons before that. One possibility is that being an area that transmits waves, including strong shaking readily, that they had to think about the consequences to the city of Semipalitirsel that is not too far away.

Dr. **Mansfield.** My records show that there were at least four tests above magnitude 6, two above magnitude 6.1, including one that they announced was a yield of 125 kilotons, the 1969 test.

Dr. **Sykes.** The 1969——

Dr. **Mansfield.** The Soviets announced a yield of the 1969 test that had a yield of 125 kilotons by the Soviet's own estimates.

Dr. **Sykes.** That is an explosion that was a peaceful explosion that made a large cavity that was put off at the test site.

Dr. **Mansfield.** So the Soviets had quite a few data points, at least five, that allowed them to judge the effects of ground motion on nearby towns and it is not convincing to me that there is a test practice after the 1976 inception of the test ban treaty that was for the purposes that you mentioned.

Dr. **Sykes.** I think it is important, however, to remember that that was not done in just one step of increase as some have suggested, that it was something that moved up in at least three steps.

Dr. **Mansfield.** You mentioned that the use of surface wave magnitudes and of the Lg method of calculation would clear up some of the uncertainties with respect to large yield inferred from body wave magnitudes at the test site. Does the community agree on that? Is there a consensus, for instance, in your colleagues on the DARPA seismic monitoring panel?

Dr. SYKES. I think there is a consensus about the use of surface waves and specifically of using a broad range of periods to estimate in a rather sophisticated way from the character of those long period waves, those are surface waves, and it has been recognized that it is now a reliable method, one in which we can take path differences into account and one in which we can take into account tectonic release.

Dr. MANSFIELD. I ask the question because it is my judgment that if I assembled a list of half a dozen experts, Nordyke or Knutley or Helberger, the people that usually sit on these things, and said you have to come up with an approved method by this afternoon to tell the Director of Central Intelligence how to estimate yields at the Kazakhstan test site, they would not come up with the recipe that you have suggested.

Dr. SYKES. I do not think that is the case, but we are getting into the area of classified reports, in which I have seen that report, the DARPA report, the two DARPA reports, and I am afraid that I have to tread rather lightly in going any further there, but that there has been a much greater consensus in the last year and that we are down to arguing about differences in 10 or 15 percent, and certainly there is not consensus at that level, but there is consensus in talking about the bias within about one-tenth of a magnitude unit.

Dr. MANSFIELD. Madam Chairman, the reason I am pursuing this line of questioning is to try to get on the record the degree to which the community is willing to say that precision in monitoring Soviet tests is possible in various areas of the Soviet Union.

Dr. Sykes, you quoted this morning the excellent capabilities of the NORSAR versus the Azgir salt dome, page 18 of your testimony. It truly is an extremely remarkable achievement to have been able to come up with this kind of clean, bright seismic look at that one test site.

Do you think that it is possible to monitor the very large areas of salt domes in the Soviet Union that are capable of leaching out cavities, capable of supporting cavities leached out for the purpose of clandestine testing to the same degree of precision that NORSAR is able to look at Azgir?

Dr. SYKES. I am not claiming a capability down to magnitude 2.0. That would be below that of 1 kiloton being fully decoupled. I am presenting to you the conclusion that if we have stations within the Soviet Union and they have a moderate high frequency capability that we will be able to monitor large areas of the Soviet Union and use these high frequency waves to thwart various evasion schemes.

Dr. MANSFIELD. So the data on page 18 of your morning testimony is very much a best-case event?

Dr. SYKES. That one example is there, but, for example, if you look at table 2 on page 15, that is taken from a semiannual report by the Norwegians and there they have made some estimates for four different areas which you can see there, and they mention for west of the Ural Mountains 2.0 to 2.5, possibly better. For the Caspian area, the Azgir test site, 2.0 to 2.5. So I give you their estimates there which are not based on the best seismogram.

Dr. **Mansfield**. My last question has to do with evasion. You indicated this morning that there were few areas where evading in salt domes would be possible. I mention salt domes because it is obvious that leaching out cavities surreptitiously is very easy there, and in my judgment it would be impossible to guarantee the President that we could catch the Soviets creating a large cavity in the middle of the woods someplace in a salt dome. Do you agree that salt domes of that nature are widespread in the Soviet Union?

Dr. **Sykes**. There is no question that there are extensive areas of salt in the Soviet Union. I think this morning I said that there are many fewer areas in the Soviet Union that have thick sequences of salt that would be suitable for having clandestine explosions conducted in cavities of, say, 1 kiloton or a few kilotons, fewer than areas of hard rock in the Soviet Union that are more distributed. So we would have to monitor a number of areas, but by no means all of the Soviet Union.

Dr. **Mansfield**. No; but is it a large fraction of the Soviet Union?

Dr. **Sykes**. By large fraction, we are probably talking about 5 or 10 percent of the Soviet Union that we have to look at here. There are certain maps that have been developed and published over the past 15 years that show potential areas of salt accumulations, and of course there are many more areas for which it would be possible to conduct a test of one-tenth of a kiloton than there would be sequences where one might think of doing 10 kilotons.

Dr. **Mansfield**. The kinds of depths that are required are measured in a few hundreds of meters for some of these cases, so it does not take enormously deep cavities to be able to do that.

Dr. **Sykes**. If you are talking about 10 kilotons, it does, so it is very important that we distinguish here in size, because for 10 kilotons you have to excavate about 10 times the volume of material that you have to do for 1 kiloton.

Dr. **Mansfield**. The excavation of salt is essentially free, it costs you nothing politically. You can very easily do it and not be seen.

Dr. **Sykes**. I think it is for this reason that the community working on verification acknowledges that this is the most important problem in monitoring a comprehensive test ban, the most important verification possibility, and that that, in fact, is what sets these upper limits.

Dr. **Mansfield**. I agree. We have to remember that we store our strategic petroleum reserve in leached holes in salt cavities sufficient to decouple large explosions.

Dr. **Sykes**. We have to remember too that occasionally some of these collapse and those features are seen very clearly in the surface of the Earth, so a country attempting to do this clandestinely has to make sure there is no equipment obviously seen in satellite photography and that none of the preparations are seen there, and that there is not a cavity or depression formed at the surface.

Dr. **Mansfield**. I agree. My point was that it is impossible to monitor large areas to look for leaching pumps. Nobody believes that the capabilities of intelligence or the patience of a photo analyst are sufficient to look at the whole Soviet Union.

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Dr. **Sykes**. That is not what I was suggesting. I was indicating that we can use satellite photograph to eliminate the possibilities of removing hard rock, other than salt, and then we are left with the salt areas of the Soviet Union. We deploy our seismometers such as to get the very best capabilities from those areas, and we use a high frequency monitoring capability there.

Dr. **Mansfield**. For evasion with chemical explosions, the Soviets have a longstanding program of seismological profiles previously used in nuclear explosions along two lines in the Soviet Union. They never announced that they were going to do those. We heard the explosions seismically and went and looked afterwards. What is to prevent the Soviets from digging a hole some place quietly and setting off a nuclear explosion in it and then telling us it was a mined hole filled with explosives?

Dr. **Sykes**. It depends on what the size of that is.

Dr. **Mansfield**. Twenty kilotons.

Dr. **Sykes**. If we are talking about 20-kilotons, that is going to make a very big seismic signal, even fully decoupled.

Dr. **Mansfield**. I am talking now about a fully coupled explosion of 20-kilotons along the seismic profileline. After the explosion, the Soviets tell us it was a chemical explosion.

Dr. **Sykes**. I am saying that something of that type, even if it is decoupled, is going to make large seismic waves, particularly high frequency ones that if we have stations in the Soviet Union we will be aware of that.

Dr. **Mansfield**. It is a fully coupled 20-kiloton explosion. The point is the Soviets tell us that it is a chemical explosion.

Dr. **Sykes**. I think that there is a case in which we clearly have some data; we would demand an on-site inspection of the challenge type. Clearly the Soviets have to put up in that case. If they do not, then the United States would regard them being in violation of the treaty.

Dr. **Mansfield**. So these evasion techniques require Soviet cooperation after the fact, and it would not be sufficient for the Soviets to say we have not violated the treaty; they would have to yield sovereignty to allow us to actually take samples or whatever?

Dr. **Sykes**. One of the things that was agreed in the negotiations from 1977 to 1980 was that there be on-site inspections—not a certain number guaranteed per year, but of the so-called challenge type, and the idea there would be that one country would have to produce some data. In this case we would clearly have some seismic data that would indicate something was going on and the treaty then would be considered as having been violated if they did not allow us an on-site inspection.

Dr. **Mansfield**. My last question, Madam Chairman——

Mrs. **Byron**. Are you sure?

Dr. **Mansfield**. You mentioned this morning that the seismic means are capable of monitoring down, testing down to some yield below which there is no military significance. If a test is below a certain small level of no military significance, then why restrict them with a treaty? What is the value of a comprehensive test ban treaty as opposed to the threshhold test ban treaty if it does not govern anything of military significance?

**Dr. Sykes.** I went into this in my testimony covering Kidder's paper in which he indicated the profile of testing and the percentage as a function of yield for the last 5 years and that there are U.S. tests that are below 1 kiloton but only 5 percent of the U.S. tests have been there. By his own words he is saying that 12 kilotons and 150 kilotons for the last 5 years have, because of their much greater numbers, presumably been of considerable military significance, at least perceived significance, and that small tests have been of perceived lower significance.

I did not use the words that they are of no significance.

**Dr. Mansfield.** Thank you, Mr. Sykes.

Madam Chairman, subject to your approval, we will submit other written material for the record.

**Mrs. Byron.** That is fine.

Thank you very much, Dr. Sykes. I appreciate your coming back this afternoon.

There was technical information we wanted to get on the record and also before the panel. I know you have travel plans and we would not keep you, but I did want to once again thank you for your testimony. I think it is important that this panel at this time of the year, after a full year's worth of hearings, sit down and really sort through this and write and publish a timely report; and it is my intention at the end of this series of hearings as of today to do just that.

We have heard numerous witnesses expressing a variety of points of view on the major arms control issues that are involved in negotiations, and I think this Congress is going to be facing many of these issues in the coming year, and for that reason I think it is important that we produce a record and a report so our work can be used during this dialog and these debates. So it is my intention today to start writing a report from the hearings.

We appreciate you being our final witness and thank you very much.

[The following was provided for the record in response to a panel request:]

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
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ARLINGTON, VA 22209-2308

DEC 16 1985

Honorable Beverly B. Byron
Chairman, Special Panel on Arms Control and Disarmament
Subcommittee on Procurement and Military Nuclear Systems
Committee on Armed Services
House of Representatives
Washington, DC 20515

Dear Chairman Byron,

I am pleased to have the opportunity to respond to the testimony presented to the Arms Control and Disarmament Panel on 20 November 1985. Perhaps the most telling conclusion from all of the technical witnesses that appeared before the Panel was the recognition that a Comprehensive Test Ban cannot be sucessfully monitored under any verification arrangements that can be practically obtained. In my testimony of 18 September 1985, I pointed out that a Comprehensive Test Ban with the Soviet Union would be, from a monitoring point of view, a low-yield Threshold Test Ban Treaty with a vague, undefined threshold. This fact has been uncontested by any of the expert testimony before the Panel.

Much of the difference between the testimony presented by myself and by Dr. Sykes on the verification of a Comprehensive Test Ban falls into two major areas:

- The way in which deliberate attempts at evasion and concealment must be taken into account; and

- The difficulties in confidently recognizing low level signals from small nuclear explosions, or decoupled larger explosions, amidst the large number of signals from earthquakes and chemical explosions.

Each of these areas has been treated in a most serious manner by the Department of Defense in its assessments of the verification potential of a nuclear test ban treaty.

Evasion

The flippant remarks by Dr. Sykes concerning the possibilities for cavity decoupling evasion gloss over a very difficult and threatening problem that must be addressed. Although it is possible that large underground cavities suitable for this purpose could be constructed in various kinds of rocks, the most practical geological formations usually considered are underground salt deposits. There is general agreement that the best verification capabilities should be focused on such regions. However, such regions are known to be very widespread. The best information available indicates that suitable bedded salt deposits and areas of salt domes together occur in at least over 2.9 million square kilometers in the Soviet Union. This is about 13% of the country and is equivalent in area to over four times the size of the state of Texas. Other areas that are not fully mapped or reported could increase this estimate.

Over 80% of the known salt areas in the Soviet Union contain salt formations which are thick enough for cavities to be constructed with volumes of 50 thousand cubic meters; easily large enough to fully decouple a one kiloton nuclear explosion. Underground cavities of this size and larger are in common use for the storage of petroleum products. Approximately 25% of the suitable salt areas contain very large salt domes, diapirs, and thick-bedded salt where cavities of about 500 thousand cubic meters could be constructed. Such cavities could fully decouple nuclear explosions of at least 10 kilotons. Solution mining of cavities of this type have been reported by the Soviets. About one half of the area suitable for the construction of these very large cavities is located in the Caspian Sea lowlands, while the remaining areas are widely scattered from near the border with Afghanistan to along the coast of the Artic Ocean.

There are indications from both theoretical work and from measurements that the cavity decoupling loses its effectiveness at high frequencies and thus, the question turns on the propagation efficiency of these signals that leak out. In my testimony, I described the ongoing research on this topic as highly promising. One can argue about the extent to which the promise of high frequency event detection has been rigorously proven--we are just beginning to collect and evaluate the relevant data. What can hardly be contested is that giving an identification to the origin of such signals (nuclear explosion, chemical explosion, earthquake, rock burst etc.) is going to be extremely difficult for the small events of concern. As yet, no technique has been demonstrated to do this.

In summary, the potential for cavity decoupling evasion is widespread in the Soviet Union, even with today's limited knowledge of the geology. It is known that there are many cavities existing today in the Soviet Union which are large enough to decouple the 8 kiloton explosion referred to in Dr. Sykes' testimony. To recognize these facts is not being pessimistic, as some would say, but pragmatic and prudent.

Dr. Sykes fails to address adequately the possibilities for evasion in environments other than underground. In such cases, the seismological methods discussed in the testimony provided to the Panel do not apply.

## Nuclear Explosion Identification

For a number of years, a rigorous research effort has been conducted to develop a robust signal analysis technique to differentiate earthquake and explosion signals using only data collected at regional distances. Thus far, such a robust technique has not been developed. The theoretical and observational work in this area has been conflicting. Dr. Sykes and his co-workers have chosen one purely theoretical approach as the solution to this problem. These untested hypotheses are presented as if they could be used universally.

In my testimony, I stated that a detection threshold of about magnitude 2.5 would be required to monitor the Soviet Union at the one kiloton level. Such a level could be achieved only by the installation of high quality stations and arrays inside the Soviet Union. Dr. Sykes stated that a less sensitive level of only 2.8 to 3.2 would be necessary for various parts of the Soviet Union. Such a statement fails to take into consideration the difference between detecting a signal and determining its nuclear origins. It is well established that the threshold for identification of seismic events, especially those at shallow depths, is larger than the detection threshold. Even assuming that discrimination procedures can be developed for signals at this level, some margin must be maintained for natural fluctuations in signal sizes and discrimination procedures. There remains a certain amount of uncertainty in all of these estimates. The values presented in my testimony represent our best current knowledge. Many of the differences between these values and those of Dr. Sykes are based on his use of optimistic and unproved assumptions.

At the one kiloton monitoring level (magnitude 2.5), there are many thousands of events occuring annually in the Soviet Union. Dr. Sykes has recently stated that it is possible to distinguish between earthquakes and small nuclear explosions of only one kiloton with 90% reliability. Even if such unfounded statements are correct, there remain hundreds of events annually which remain unidentified-each one a potential nuclear explosion. In order for the on-site inspection measures to be meaningful, the number of such unidentified events must be reduced to a more manageable number.

Dr. Sykes and I agree that at the present time, there is no seismic method for proving that an explosion is nuclear rather than chemical. This is one of the key concerns about CTBT verification capabilities. At the one kiloton monitoring level there will be many such chemical explosions that must be examined. Negotiating the on-site inspection provisions for monitoring such explosions would be a difficult matter and would require Soviet agreement to very intrusive verification measures that are certainly unprecedented. This task should not be underestimated.

## Yield Estimation

The seismological methods which can be used to monitor the 150 kiloton Threshold Test Ban Treaty have been under intense investigation and review within the Department of Defense for several years. Inherent in these methods are critical assumptions involving the geophysical character of the Soviet nuclear test sites and the conditions within the earth near those sites. No conclusive proof of these various assumptions is possible without direct and trustworthy information from the Soviet test sites themselves. The scientists involved in this research and review use their best professonal judgement to select the most reasonable assumptions. On the yield estimation question, there has been, and continues to be, a range of professonal judgements on these assumptions amoung the most knowledgeable and experienced geophysicists in this country. Dr. Sykes represents one extreme in the assumptions he advocates (leading to lower yield estimates than most). There are others, just as responsible and knowledgeable, who advocate extreme assumptions on the opposite end (leading to higher yield estimates). The reviews conducted by the DoD have tended to balance these extremes.

Dr. Sykes' assertion that seismic yield estimates of Soviet underground nuclear explosions can be made with a precision of 30% is overly optimistic about many of the aspects of this problem. Such a claim seems to ignore the possibility of variations in the coupling of explosion energy to seismic waves. This question cannot be resolved with the available seismological data. Direct information from the Soviet test sites is required. While it may be plausible to assume that the geological variations at the Nevada Test Site are greater than at the Soviet Semipalatinsk test site, we certainly do not know this to be the case.

Dr. Sykes gives a hypothesis for the increase in the size of yields tested at the Semipalatinsk site after the TTBT had been in effect for several years. This hypothesis ignores the fact that there were at least four underground explosions at the Semipalatinsk site before 1976 that appear to be as large, or larger, than the biggest test since 1976. The scenario of sudden Soviet concern about the level of ground shaking strikes those who are knowledgeable about Soviet practices as absurd.

I hope the Panel finds these remarks useful in its deliberations.

Sincerely,

RW Alewine

Ralph W. Alewine, III
Director, Geophysical
Sciences Division

**Department of Energy**
Washington, DC 20585

December 16, 1985

Mr. Adam J. Klein
Counsel
Committee on Armed Services
House of Representatives
Washington, D.C. 20515

Dear Mr. Klein:

In your December 5, 1985, letter to Gordon Vander Till, you requested that departmental witnesses who appeared before Chairman Byron's Special Panel on Arms Control and Disarmament on September 18, 1985, review the November 20, 1985 transcript, particularly the testimony given by Dr. Lynn R. Sykes, Professor of Geological Sciences at Columbia University.

The witnesses have reviewed the testimony and offer their comments as appended to this letter. If you have any questions, please call Hank Edler or Cathy Hamilton of my staff on 252-4277. They will be happy to assist you.

Sincerely,

Robert G. Rabben
Assistant General Counsel
for Legislation

Enclosure

## RESPONSE TO ADAM KLEIN'S LETTER REQUEST, DATED DECEMBER 5, 1985

General. As an outspoken advocate of a nuclear test ban, Dr. Sykes has understandably couched his testimony in terms that downplay any possibility of undetected Soviet noncompliance with a test ban treaty. It is understood that the Panel will read his testimony in that context, as representing one extreme of a spectrum of views on the subject.

With regard to specific statements in the Sykes testimony, several warrant special comment.

Page 29, lines 679-681. "When this methodology is employed, it is evident that the Soviet Union has not violated the 150 kiloton limit of the Threshold Test Ban Treaty." This statement is demonstrably incorrect, in that it states as fact something that cannot possibly be proved from the data. In cross-examination (Page 86, lines 2034-2045) Mr. Mansfield notes that even if Dr. Sykes' most generous formula for estimating Soviet yields is used, there are several tests that appear to be nominal violations of the threshold. Dr. Sykes does not deny this, but suggests that these apparent violations result merely from random uncertainties in estimation. What he fails to observe is that uncertainty can work in either direction. Specific values are of course classified, but suppose for example that a certain test appears, using the Sykes methodology, to have a yield of 200 kilotons. Using the widely accepted factor-of-two uncertainty, we would have to admit in fairness that the true yield could be as low as 100 kilotons; but Dr. Sykes would have to admit in comparable fairness that the true yield could be as high as 400 kilotons. Of the "six or seven" tests noted in the Mansfield questioning as being apparent violations of the 150 kiloton threshold, any could conceivably have been in excess of 300 kilotons. Arguably, the uncertainties in the data could preclude absolute proof that there have been violations; but to say that "it is evident" that there have been no violations is clearly incorrect.

Page 30, lines 700-703. "Seismic data now provide accurate estimates of the sizes of large Soviet weapons tests...." This of course depends on what one means by "accurate," but there is ample testimony indicating that such estimates are not accurate enough for these purposes. Reputable seismologists differ substantially even in their best estimates of the yields, and any one of those estimates might itself be in error by a factor of two or more. Administration judgment is that teleseismic yield estimation, while a very valuable tool in research, is in no sense capable of providing estimates of sufficient accuracy to warrant reliance on it for verification at this time.

Page 34, lines 785-786. "The number of weapons tests from 1963 to 1985 greatly exceeds the number of tests prior to 1963." While technically correct, this is a misleading statement that obfuscates more than it informs. Extensive nuclear testing did not begin until the mid-1950s. It is hardly surprising that there were fewer tests in the 10-year period from 1953-63 than in the 22-year period from 1963-85. In fact, the rate of nuclear testing has substantially diminished in recent years.

Page 38, lines 902-906. "The volume of rock that must be excavated to fully decouple an explosion of about eight kilotons is approximately equivalent to the volume of the largest Egyptian pyramid...." Again, this statement is an attempt to dramatize and not to inform. Creation of such large cavities would be feasible either by solution mining or by using nuclear explosives for the excavation, e.g., in underground salt beds. Not only is it possible that such cavities are being created today and "stockpiled" for future illegal tests, but it is generally believed that some already exist -- allegedly for natural gas storage.

Page 41, lines 981-984. "It is clear that high frequency seismic waves and the use of other national technical means can reduce the possibilities of clandestine testing to explosions of a very small size." In fact, we do not know today how large a clandestine test might be. In particular, we do not know how well high frequency measurements would discriminate between nuclear explosions and earthquakes. Dr. Sykes' own testimony in the preceding four pages indicates that high frequency seismic analysis is an experimental research tool, not a technique of demonstrated scientific validity. There have been no nuclear experiments (in this country) to demonstrate whether or not high frequency monitoring is really resistant to decoupling attempts. Dr. Sykes' statement is one of speculation, not fact.

Page 42, lines 1001-1004. "This (hide-in-earthquake) scenario has a major disadvantage in that nuclear weapons must be kept in readiness in a totally clandestine manner for long periods of time awaiting an earthquake of sufficient size." Of course this is a disadvantage, but the scenario is in fact not at all infeasible. The most obvious way to implement it would be to prepare a weapon for testing and then have the actual detonation be triggered by the earthquake itself. There is no apparent scientific reason why this could not be done, and of course we have no way of knowing whether the Soviet Union has ever done it.

Page 45, lines 1057-1060. "The military significance of tests below one kiloton was perceived to be very low by those conducting the testing program." There are several things wrong with this totally unwarranted statement. First, since neither the U.S. nor the Soviet Union announces all its nuclear tests, unclassified data sources (and even some classified data sources) will always understate the number of very small tests. Second, there is no justification whatsoever for the assumption that the number of tests provides a direct measure of the military significance of those tests; in particular, it is obviously unnecessary today to conduct many low-yield tests simply because much of the desired information is gleaned from higher-yield tests being conducted for other purposes. Third, and most important, the military significance of low-yield tests would certainly increase if low-yield tests were the only ones allowed, or the only ones that could be illicitly conducted in a CTB environment. This seems to us to be both obvious and crucial.

Page 47, lines 1105-1108. "It is evident that the Soviet Union, like the United States, has tested repeatedly close to the limit of the threshold treaty since 1976, but has not tested significantly above it." This statement implies a nonexistent level of accuracy in yield estimation. For us to verify that a given yield is close to 150 kilotons, but not much greater than 150 kilotons, clearly requires that we know that yield almost exactly. For Soviet tests, that is certainly untrue.

Page 49, lines 1150-1165. On this page, Dr. Sykes argues that because our estimates of Soviet yields indicate that most of their testing has been in the area of 500 kilotons, Dr. Nitze's estimates of 750 kilotons for certain Soviet weapon yields are too high. For at least two reasons, one cannot justify such an inference. First, our yield estimation procedure is not that accurate; it is entirely possible that at least some of what appeared to be 500 kiloton tests were in reality at the 750 kiloton level or even higher. Second, weapons need not be tested at full yield. There are any number of reasons (cost of deep emplacement being the most obvious) that the Soviets might choose to do most or all of their highest-yield weapon certification tests at fractional yield levels.

Although the foregoing comments relate entirely to Dr. Sykes' testimony as requested, we would also like to point out one particularly egregious misstatement in the testimony of Dr. Tsipis. In response to a question from Chairman Byron (Page 104, lines 2477-2484), Dr. Tsipis stated that "I believe that there is congressional testimony from laboratory directors that at that time (following the 1959-61 testing moratorium) there was no serious question as to the reliability of our weapons." In fact, testimony before the Arms Control Panel on September 18-20 indicated just the opposite. We have also distributed to the Panel members a document by Jack Rosengren, "Some Little-publicized Difficulties With A Nuclear Freeze," that testifies to such reliability problems. It is not clear what Dr. Tsipis meant.

**Mrs. Byron.** The panel stands adjourned.

[Whereupon, at 3 p.m., the panel was adjourned.]

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# BRIEFING ON RECENTLY TABLED U.S. AND NATO PROPOSALS BEFORE THE MUTUAL AND BALANCED FORCE REDUCTIONS [MBFR] TALKS

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House of Representatives, Committee on Armed Services, Special Panel on Arms Control and Disarmament of the Procurement and Military Nuclear Systems Subcommittee,
*Washington, DC, Wednesday, December 12, 1985.*

The panel met, pursuant to call, at 10:25 a.m., in room 2118, Rayburn House Office Building, Hon. Beverly B. Byron (chairman of the panel) presiding.

## STATEMENT OF HON. BEVERLY B. BYRON, A REPRESENTATIVE FROM MARYLAND, CHAIRMAN, SPECIAL PANEL ON ARMS CONTROL AND DISARMAMENT OF THE PROCUREMENT AND MILITARY NUCLEAR SYSTEMS SUBCOMMITTEE

Mrs. Byron. The panel will come to order.

This morning the panel will receive a special oversight briefing on the latest developments in the Mutual and Balanced Force Reductions [MBFR] talks. On December 5, the United States and NATO allies introduced a new proposal at the Vienna talks which we hope will help to move these negotiations along toward a verifiable agreement.

On behalf of the panel, I want to express my appreciation to Ambassador Robert Blackwill, our representative to the MBFR talks, for making himself available to brief us this morning.

I note that the statement of the President issued on December 5 indicates that NATO has made several important concessions. In return for these concessions, it appears that the NATO Alliance also desires an agreement on verification measures.

I would certainly hope that the new NATO position would result in some movement in these negotiations that have lasted more than 12 years. I would hope that the new position does not merely represent a quick fix or a political move, but I would also hope that we would insist on an adequate verifiable agreement containing appropriate on-site inspection procedures. If this is not the result, we have wasted many years for no purpose at all.

[The following information was received for the record:]

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THE WHITE HOUSE

OFFICE OF THE PRESS SECRETARY

*For immediate release, December 5, 1985*

Statement by the President

Consistent with the Joint Statement issued by General Secretary Gorbachev and the President at the conclusion of the Geneva meeting, and with our efforts to promote a more constructive East-West relationship, we and our NATO Allies are introducing in Vienna today a new proposal designed to break the long deadlock on conventional arms reductions in Europe.

Since the early 1970's, NATO has engaged the Warsaw Pact in discussions aimed at limiting the numbers of troops on both sides in Central Europe. These discussions, known as the Mutual and Balanced Force Reduction Talks (MBFR), now constitute one of the longest continuously running arms control negotiations in history.

The NATO Allies have consistently tried to move these negotations forward. In 1982 and 1984, the U.S. and Allies presented new proposals designed to achieve progress in the MBFR negotiations. Regrettably, both proposals were rejected by the Warsaw Pact. After extensive national reviews of these talks and their objectives, we and our Allies have concluded that a significant and forthcoming new move could provide new impetus to the negotiations.

In an effort to move the negotiations forward, and taking into account expressed Eastern concerns, we have today tabled a new proposal for reductions with effective verification.

The proposed package of verification measures is intended to verify the numbers of troops withdrawn as well as the numbers which will remain. Thus, in exchange for a comprehensive and effective package of verification measures, NATO would be willing to accept the general framework of the February 1985 model proposed by the Soviet Union and its allies for a non-comprehensive agreement. We will no longer insist, as we have since the outset of negotiations, that the sides come to an agreement on Eastern troop levels before treaty signature. Nor will we continue to insist, for now, on a comprehensive approach whereby East and West must agree at the outset on all the steps needed to reduce to parity.

In this context, the U.S. is now prepared to accept a reduction of 5,000 U.S. and 11,500 Soviet ground troops in the central European reduction area. These figures reflect the ratio between existing U.S. and Soviet troop levels in the area.

As soon as these reductions are completed, NATO is prepared to accept a commitment by both alliances not to increase forces in central Europe. As verified by implementation of the verification measures, this no-increase commitment would last for three years.

The new Western proposal builds on key aspects of the Warsaw Pact's ideas of February 1985. These include: a time-limited, non-comprehensive agreement; reductions without prior data agreement on Eastern forces; and a no-increase agreement. The main element which NATO has added is in the area of verification.

Fair, effective and reciprocal verification measures are essential so that both sides will be able to know whether the terms of the accord are being complied with. This is especially important if we are to accept a no-increase commitment on troops in the area without prior agreement on the level of those troops. The Soviets have contended that such prior agreement was unnecessary and that Western concerns could be satisfied through implementation of verification measures. This new Western proposal offers them an opportunity to pursue that approach. Agreement on all aspects of the proposed verification measures would of course have to be reached prior to the signature of a treaty.

We urge the Soviet Union and the other Warsaw Pact countries to consider carefully the details of our proposal. This NATO initiative can help fulfill the commitments made at the Geneva Summit and produce real progress in Vienna which would reduce forces in Central Europe.

Mrs. BYRON. I want to take this opportunity to thank Ambassador Blackwill for the hospitality that he showed this panel when we were in Vienna back in the end of September to early October timeframe, and I welcome you to the panel and look forward to your briefing this morning.

Thank you very much.

## STATEMENT OF AMBASSADOR ROBERT BLACKWILL, U.S. REPRESENTATIVE TO THE MUTUAL AND BALANCED FORCE REDUCTIONS [MBFR] TALKS

Ambassador **Blackwill**. Thank you, Madam Chairman. I too enjoyed having you there and I hope you and your associates will find an opportunity to visit us again after the next round beginning at the end of January. It promises to be one of the most interesting rounds we have had in Vienna for some years.

What I would like to do, if I might, is read a brief prepared statement. What I think I will do, however, seeing familiar faces up there, is skip past the general background, which I know you are familiar with, both from previous hearings and from your visit to Vienna, only summarizing it briefly and then getting to the new proposal which we put down at the end of last week.

As you know, the negotiations began in 1973, and Newsweek magazine, a couple of months ago, said that the MBFR negotiations have given new meaning to the words "slow motion." I think that is a fair statement. For 12 years the two sides have gone back and forth with proposals and counterproposals, and although there has been some area of agreement, in fact they have remained very wide apart on the fundamental issues, especially with respect to two of them: First, the so-called data question, which I discussed before this panel in September, and then we subsequently talked about in Vienna.

That issue, as you know, relates to the number of Warsaw Pact forces in the area of reduction with the NATO side believing that the Eastern figures put down in 1976, and then again in 1980, understate the number of Warsaw Pact forces in the area by about 230,000 men.

The second issue is one of verification, and for the 12 years of the negotiation the Warsaw Pact has simply been unwilling to agree to the sorts of serious verification measures which we believe are necessary in order to promote compliance with the agreement.

With that brief introduction, let me then tell you a bit about the new proposal

### MBFR NEGOTIATIONS

After extensive national reviews of these MBFR talks and their objectives, we and our NATO allies recently concluded that a significant and forthcoming new move could provide new impetus to the negotiations. Consistent with the Joint Statement issued by the President and General Secretary Gorbachev at the conclusion of the Geneva summit meeting—and with our efforts to promote a "fresh start" and a more constructive East-West relationship—the United States together with our NATO allies introduced on December 5 a major new proposal designed to break the long deadlock in Vienna.

Despite our continuing conviction that prior agreement on force data would have been the more sensible and effective means to making progress, NATO now is willing to drop this longstanding, important aspect of its position in the interest of breaking the logjam at the Vienna talks. This move comes in response to repeated Eastern suggestions over the years that if the West were to drop demands for prior data agreement, substantive progress could be made—indeed, that the path would be cleared to an agreement.

In addition to this major step, the West now accepts the general framework of the East's February 1985 "basic provisions" proposal. That is, we agree to negotiate on a time-limited, first-phase agreement consisting of: Initial United States and Soviet ground force reductions. Followed by a no-increase commitment covering the forces in Central Europe of all participants in the MBFR negotiations.

This willingness to accept the framework proposed by the other side is an important development. In the past, the negotiations have been characterized by one side advancing a proposal, followed by the other side—usually after some interval—tabling a counterproposal. Too often these have borne little or no relation to each other. As we have called it in Vienna, it has often been a dialog between the deaf, between NATO and the Warsaw Pact.

Now, for the first time in the negotiations, the sides—as a result of the Western move—are in a position where they are talking about the same kind of approach at the same time.

Whether this marks a beginning of real negotiations will depend, of course, upon the Eastern reaction to our proposal.

With regard to the specifics of the Western proposal, we have identified at least 16 specific points on which, as a result of the West's review of its position and subject to resolution of detail, there would now seem to be broad agreement between the two sides. These are identified in the attachment to my statement. There also are a number of areas in which the sides appear to be in near agreement—for example, on a provision allowing for normal peacetime military activities such as NATO reinforcement exercises and the callup of reservists for training.

The most important differences between the new Western positions and those of the East are as follows.

First, the West is now proposing that initial reductions should be 5,000 American and 11,500 Soviet ground troops. These figures reflect the ratio of United States, and Soviet forces in the reductions area. The new figures thus continue to provide for a proportionate level of reductions and would be manageable and adequate to test the reduction and verification procedures of this first-phase agreement.

Second, while the East has proposed that troops to be withdrawn take with them their organic armaments and combat equipment, the West proposes that, in order to achieve a timely first-phase agreement, each side should have discretion to decide for itself how to deal with such armaments. Moreover, we do not believe it would be meaningful or practicable to apply a no-increase commitment to armaments, as the East has proposed. Indeed, the East itself has begun to recognize recently the difficulties of including armaments in a limitations agreement of the kind that we are discussing.

Third, as noted previously, the East envisages minimal provisions for verification. The West proposes an effective verification regime which has several key features:

(A) It converts the observation points proposed by the East into permanent and permanently manned entry and exit points through which all forces—those entering as well as those leaving the reductions area—should pass.

(B) It provides for the exchange of detailed information, disaggregated down to the battalion level, on forces remaining in the reductions area after initial United States and Soviet withdrawals. The initial information exchange would constitute the basis for verifying the no-increase commitment that side would undertake.

(C) It provides for an inspection regime under which each side would have the right to conduct 30 inspections during each of the 3 years immediately following the completion of United States and Soviet reductions.

(D) It provides for the establishment of a consultative commission, whose tasks would include clarifying ambiguities expeditiously and helping to resolve disputes.

Fourth, while the East envisages both alliancewide and national ceilings on armed forces, the West believes the no-increase commitment should simply be alliancewide, with subceilings only on United States and Soviet forces, since they are the only forces involved in initial reductions.

Finally, as in any international agreement of this kind, the West proposes to include a clause recognizing the right of each side to take steps to protect its security interests in the event of activities by the other side which are incompatible with the object or purposes of the agreement, or which jeopardize those interests.

It is too soon to predict how the negotiations will evolve in the wake of the West's new proposal. The Western move, however, offers a unique opportunity to maintain the momentum following the Geneva summit and to produce real progress in Vienna.

The Soviet representative, on behalf of the East, said a week ago today when we put down this proposal that the Western proposal would be "thoroughly studied." We will probably have to wait until the next negotiating round, which begins on January 30, before any authoritative Eastern views are registered. It was, however, disappointing that the Soviet representative, as a preliminary reaction, also ventured to express the view that the Western proposal "does not inspire optimism" and to suggest that the Western position on dealing with armaments and verification "does not contribute to the achievement of a mutually acceptable agreement." Eastern press reaction we have seen thus far, moreover, has followed this line and has failed to acknowledge in the slightest the many positive elements in the new NATO initiative.

This said, it is now up to the Soviet Union and its Warsaw Pact allies to show that they can match the West in flexibility, imagination and pragmatism.

Madam Chairman, if I might just add one last point which follows from your opening remarks. We are of the view within NATO that this proposal with the sort of adequate verification measures which are an intrinsic part of it is a proposal which would serve both the objective of reducing tension and confrontation in Europe, and serve the West's security interests.

If, however, the proposal did not contain, or an agreement did not contain adequate verification, then it would no longer serve those purposes, and we have agreed in NATO that the sort of package which we have put forward to the East at the end of last week is a package required, a verification package required to insure that both sides comply with the terms of the agreement.

Thank you, Madam Chairman. I would be delighted to take your questions.

[The statement of Ambassador Blackwill follows:]

### PREPARED STATEMENT OF AMBASSADOR ROBERT BLACKWILL

Mrs. Chairman, distinguished members of the Panel and other Committee members, I am very pleased to be here today to discuss the Vienna negotiations on Mutual and Balanced Force Reductions (MBFR) with you. As you are aware, the NATO allies participating in these talks put forward to the Warsaw Pact last week an imaginative and far-reaching proposal aimed at breaking the decade-long deadlock in these discussions on conventional force reductions in Central Europe.

Before turning to this new Western move, perhaps some general comments regarding the Vienna negotiations are in order.

These talks, which now constitute the longest continuous arms control negotiations in history, are a unique case of NATO-Warsaw Pact dialogue. They are the only forum in which we and our NATO partners regularly discuss security concerns and arms control with the Warsaw Pact on an alliance-to-alliance basis. As you know, our NATO allies attach great political and military importance to MBFR—not least because it is an East-West arms control forum in which they are able to participate directly and actively.

This said, the talks have failed to date to achieve their declared objective—that is, the negotiated reduction and limitation of forces in Central Europe. During the past 12 years, some progress has been made on several issues, but real success has remained out of reach. Fundamental differences have persisted on two key points.

First, there has been a long standing disagreement over the number of Warsaw Pact troops stationed in Central Europe—the so called "data issue." Since the outset of the negotiations in 1973, the West has tried unsuccessfully to persuade the East of the merits of first reaching a common understanding on the size of forces in the reductions area.

Second, the sides remain far apart on the question of verification. There are differences on the actual scope and functioning of negotiated verification measures and on the necessary degree of intrusiveness of the verification regime. There are also differing views over the question of when measures should go into effect, i.e., during or after reductions. The East has so far refused to accept verification measures as precise and comprehensive as those proposed by the West.

#### NEW PROPOSAL

After extensive national reviews of these talks and their objectives, we and our NATO allies recently concluded that a significant and forthcoming new move could provide new impetus to the negotiations. Consistent with the Joint Statement issued by the President and General Secretary Gorbachev at the conclusion of the Geneva Summit meeting—and with our efforts to promote a "fresh start" and a more constructive East-West relationship—the United States together with our NATO allies introduced on December 5 a major new proposal designed to break the long deadlock in Vienna.

Despite our continuing conviction that prior agreement on force data would have been the more sensible and effective means to making progress, NATO now is willing to drop this long-standing, important aspect of its position in the interest of breaking the decade-long logjam at the Vienna talks. This move comes in response to repeated Eastern suggestions over the years that if the West were to drop demands for prior data agreement, substantive progress could be made—indeed, that the path would be cleared to an agreement.

In addition to this major step, the West now accepts the general framework of the East's February 1985 "basic provisions" proposal. That is, we agree to negotiate on a time-limited, first phase agreement consisting of:

Initial United States and Soviet ground force reductions.

Followed by a no-increase commitment covering the forces in Central Europe of all participants in the MBFR negotiations.

This willingness to accept the framework proposed by the other side is an important development. In the past, the negotiations have been characterized by one side advancing a proposal, followed by the other side—usually after some interval—tabling a counter-proposal. Too often these have borne little or no relation to each other, thus limiting practical possibilities for real negotiation. Now, for the first time in the negotiations, the sides—as a result of the Western move—are in a position where they are talking about the same kind of approach at the same time.

Whether this marks a beginning of real negotiations will depend, of course, upon the Eastern reaction to our proposal.

With regard to the specifics of the Western proposal, we have identified at least 16 specific points on which, as a result of the West's review of its position and subject to resolution of detail, there would now seem to be broad agreement between the two sides. These are identified in the attachment to my statement. There also are a number of areas in which the sides appear to be in near agreement—for example, on a provision allowing for normal peacetime military activities such as NATO reinforcement exercises and the call-up of reservists for training.

The most important differences between the new Western positions and those of the East are as follows.

First, the West is now proposing that initial reductions should be 5,000 American and 11,500 Soviet ground troops. These figures reflect the ratio of U.S. and Soviet forces in the reductions area. The new figures thus continue to provide for a proportionate level of reductions and would be manageable and adequate to test the reduction and verification procedures of this first phase agreement.

Second, while the East has proposed that troops to be withdrawn take with them their organic armaments and combat equipment, the West proposes that, in order to achieve a timely first-phase agreement, each side should have discretion to decide for itself how to deal with such armaments. Moreover, we do not believe it would be meaningful or practicable to apply a no-increase commitment to armaments, as the East has proposed. Indeed, the East itself has begun to recognize recently the difficulties of including armaments in a limitations agreement.

Third, as noted previously, the East envisages minimal provisions for verification. The West proposes an effective verification system which has several key features:

(A) It converts the observation points proposed by the East into permanent and permanently manned entry and exit points through which all forces—those entering as well as those leaving the reductions area—should pass.

(B) It provides for the exchange of detailed information, disaggregated down to the battalion level, on forces remaining in the reductions area after initial U.S. and Social withdrawals. The initial information exchange would constitute the basis for verifying the no-increase commitment.

(C) It provides for an inspection regime under which each side would have the right to conduct 30 inspections during each of the three years immediately following the completion of U.S. and Soviet reductions.

(D) It provides for the establishment of a consultative commission, whose tasks would include clarifying ambiguities expeditiously and helping to resolve disputes.

Fourth, while the East envisages both alliance-wide and national ceilings on armed forces, the West believes the no-increase commitment should simply be alliance-wide, with sub-ceilings only on U.S. and Soviet forces, since they are the only forces involved in initial reductions.

Finally, as in any international agreement of this kind, the West proposes to include a clause recognizing the right of each side to take steps to protect its security interests in the event of activities by the other side which are incompatible with the object or purposes of the agreement, or which jeopardize those interests.

## CONCLUSION

It is too soon to predict how the negotiations will evolve in the wake of the West's new proposal. The Western move, however, offers a unique opportunity to maintain the momentum following the Geneva Summit and to produce real progress in Vienna.

The Soviet representative, on behalf of the East, has promised that the Western proposal would be "thoroughly studied." We will probably have to wait until the next negotiating round, which begins on January 30, before any authoritative Eastern views are registered. It was, however, disappointing that the Soviet representative, as a preliminary reaction, also ventured to express the view that the Western proposal "does not inspire optimism" and to suggest that the Western position on dealing with armaments and verification "does not contribute to the achievement of a mutually acceptable agreement." Eastern press reaction we have seen thus far, moreover, has followed this line and has failed to acknowledge the many positive elements in the new NATO initiative.

This said, it is now up to the Soviet Union and its Warsaw Pact allies to show that they can match the West in flexibility, immagination and pragmatism.

### ATTACHMENT—POINTS OF AGREEMENTS

As a result of the West's review of its position and subject to resolution of the details, there would now seem to be broad agreement between the two sides on the following points:

1. The concept of a first-phase agreement as providing a general framework for our future work.
2. The omission in the context of a first-phase agreement of any reference to the need for prior agreement on data.
3. Initial reductions by the United States and the Soviet Union within one year from the entry into force of the agreement.
4. Reductions in units, with up to 10 percent as individuals.
5. Withdrawn forces shall return to within their national boundaries.
6. Withdrawn forces shall not be deployed in new locations in such a way as to diminish the security of any state participant in the negotiations, including those with special status.
7. Lists shall be exchanged of the American and Soviet military units to be withdrawn from the area of reductions.
8. The United States and the Soviet Union shall inform all parties about the start of the practical arrangements to reduce their ground forces in Central Europe, and about their completion.
9. Observation points should be established through which withdrawn Soviet and American forces shall pass.
10. Each side should determine independently the location of these points in its own territory.
11. There shall be a no-increase commitment following the period of reductions.
12. National technical means of verification should be used in a manner consistent with generally recognized principles of international law and the sides should undertake not to interfere with the national technical means of verification of the other side.
13. The agreement envisaged should be of limited duration.
14. Implementation of a verification regime would also provide most valuable experience in applying associated measures, which would prove useful in the future in the course of more substantial reductions.
15. The agreement should be legally binding.
16. The East proposes that the sides should undertake to pursue the negotiations on the reduction of armed forces and armaments in Central Europe with the object of reaching parity at equal collective levels of up to 900,000 men including up to 700,000 men in ground forces. The West agrees that, subject to the successful implementation of a first-phase agreement, this should remain our objective.

Mrs. BYRON. Thank you very much, Mr. Ambassador.

Let me touch on a couple of things that have concerned all of us here; that is, the main stumbling block that we had seen in the past was at what numbers do you start to withdraw from. It looks like we have decided to do it differently, and go with withdrawing *x* numbers. Would the ground forces be withdrawn by units, by individuals in small groups, or a total package? I think we have all looked at where we have gone with the deployment of the Pershing and the GLCM's. Would the proposal affect the deployment of GLCM in Belgium or the Netherlands which is about to take place?

### DEPLOYMENT OF MISSILES IN BELGIUM AND THE NETHERLANDS

Ambassador BLACKWILL. To take all three points in sequence. On the first one, you are quite right that in dropping our requirement for prior data which had been a requirement that NATO had insisted upon for 12 years, we have changed the focus of the negotiations, and as I said in my statement, we have opened an opportunity if they respond positively, to really make progress for the first time in 12 years——

Mrs. BYRON. That is a very major change.

Ambassador **Blackwill**. Yes, that is a major concession on the part of the West. And it was seen as such by the Reagan administration and indeed by all of the NATO allies who participated in the deliberations about this move. With respect to——

Mrs. **Byron**. Let me interrupt on that point. Have you gotten any feedback or feeling back from the Warsaw Pact nations as to the effect of that from their perspective?

Ambassador **Blackwill**. Yes, we have, and unfortunately it has been negative. I, as is the tradition in these negotiations, had a bilateral session with my Soviet colleague, to explain the position to him. Then we met in a somewhat larger forum the next day a week ago Tuesday, in Baden, at his residence, south of Vienna. And we went over it in more detail. Then, again, we presented it formally in the plenary a week ago. On none of those occasions did the Eastern side acknowledge that the West had made any concessions.

Now, one can speculate why this is the case. It may be because they had no instructions from Moscow. And after all, it was a relatively short time, that is to say from Monday through Thursday, in order for them to respond. It may mean something more discouraging and disquieting, which is to say that they are not going to recognize the nature of the concession. We will just have to see when they come back formally in the next round what their view is.

Let me just say again that when they do return on the 30th of January, we really do have an opportunity to negotiate, because as I said in my statement, for the first time in more than a decade, the two sides have now agreed on a general framework for the kind of agreement which would emerge from these negotiations, and it is now possible to build on that intensely to move toward an MBFR agreement.

I think one must have participated over the years in this negotiation to get a sense of how formalized it has been, and how little real exchange has taken place often during the course of the negotiations. Well, that can change now with the right sort of Eastern reaction.

With respect to your second question, our proposal is for 90 percent of the withdrawn forces to be in units, which is really not different in any important respect from the eastern proposal. Ninety percent would be in units, and 10 percent as individuals, to give the military authorities on the two sides some flexibility. And as I say, that is consistent with the Eastern proposal as well.

Finally, no, this proposal would not affect the deployment of GLCM's in either Belgium or Holland.

Thank you.

Mrs. **Byron**. I have several other questions, but, Mr. Ray, do you have any questions?

Mr. **Ray**. Thank you, Madam Chairman.

Mr. Ambassador, we are mighty glad to have you here this morning. I guess from one of the things I picked up in your comments is that verification, of course, is the key, and that you see us running into this same brick wall, so to speak, on verification, if things begin to fall in place on this proposal?

### VERIFICATION

Ambassador **Blackwill.** Well, of course the East will have to speak for itself on that matter, but I would say this, that it is not the NATO's obligation to solve all the East's problems for it. What we have done is put down the verification regime which is designed to promote compliance.

Let me just say a word about that, just to explain the nature of the on-site inspections that we have in mind. If you think of the task which a verification regime must accomplish, it is a daunting one, because in the no-increase commitments that are now envisaged by both sides, there would be a no-increase commitment on forces of about 1 million men on each side, more on theirs in fact.

And of course if you think of trying to verify manpower levels of 1 million men, it is an awful lot of people, and we believe that the combination of the information exchange, when they would have to put down numbers and locations and subordinations of these military units, and the on-site inspections will allow us to verify whether they are either at or beneath the no-increase levels that they in fact have tabled, we don't believe that that could be done, if the verification package was weakened.

Just to put it very starkly, as I said before, this is a good proposal with an adequate verification regime, and it is a lousy proposal if it didn't have an adequate verification regime.

Mr. **Ray.** I know that verification gives it the credibility that is necessary. President Reagan, in his address before the joint session when he returned, made one statement in the accomplishments, in which he said that he and the Secretary General had reached some very tough verification agreements. I haven't been able to find out what that meant. Can you kind of pick up on that, or do you know anything about it?

Ambassador **Blackwill.** Not on that specific point. I can say, though, that I think that the discussions in Geneva at the summit on this subject did clearly give it a boost, a political impulse within the West. For the first time in many years this negotiation came to the attention of the highest levels in Government in our country and in our NATO allies' governments as well, and I think that one of the unanswered questions is whether now the same thing will happen in the Soviet Union, or whether they will treat it in the same way at lower levels.

Of course, it is our hope that given the fact that this negotiation was a subject of discussion in Geneva at the summit, that the two leaders jointly agreed that they wanted progress in the MBFR negotiation, that in the Soviet Union now this will go up to the political level, and they will look at all these matters, including the question of verification, in a different way than they have in the past.

Mr. **Ray.** Thank you, Mr. Ambassador. Madam Chairman, thank you.

Mrs. **Byron.** Mr. Mavroules.

Mr. **Mavroules.** Thank you.

Thank you, Mr. Ambassador. I just want to pursue this somewhat. When Mrs. Byron and I and I believe Mr. Ray a couple of years ago attended some of those talks in Europe, the one problem that we had in discussing it with the Soviet Ambassadors, at the request of our own Ambassadors, is that they wanted to talk about verification, perhaps reach agreement, then maybe discuss verification 3 years down the road, and of course that makes it very, very difficult for us.

I would hope that you are beginning to key in on that kind of argument. I really don't see any reason for agreement, unless we can verify what we are doing and that goes whether it is strategic or whatever.

The one point I would like to make, though, was it our recommendation to reduce our forces by 5,000 and the Soviets by 11,000? Am I correct? Did I hear you say that, Mr. Ambassador?

### FORCE REDUCTION IN EUROPE

Ambassador **Blackwill**. Yes, 11,500.

Mr. **Mavroules**. Now, assuming that is accepted, do we have—I will ask a couple of questions and you can respond—do we have other future dates to trigger even more reductions, and in the event that this would be agreed to by the Soviet Union and the United States, what would be the remaining numbers relative to personnel between the United States and the Soviet Union? Could you answer that for us, please?

Ambassador **Blackwill**. Yes.

First of all, the numbers are 5,000 and 11,500. Let me say a bit about those numbers. They represent about a 2.3-to-1 ratio, which is our judgment, and it is a judgment that we have held for many years, about the ratio of United States and Soviet forces in the area of reduction, and these numbers reflect that same ratio.

On the question of future reductions, the answer is a very decisive yes, that both sides have committed themselves to reducing their forces in the reductions area to parity, to 700,000 ground forces and 900,000 ground and air combined, and we said last Thursday, 1 week ago today, in Vienna at the plenary, and I also stressed this very strongly to my Soviet colleague in my bilateral session, that we very much still share that objective, and that if this first-phase agreement can reach a successful conclusion, then we would move expeditiously to continue the reductions process.

What the East has argued, since February when they put down their proposal, was that perhaps the two sides had been too ambitious over the years in trying to do too much at once and perhaps a building block approach in which you incrementally tried to chew on what is obviously a very tough piece of meat here would produce a result, and so we have essentially agreed with that approach, and if it does produce a result, then we would move immediately to further reductions.

On the question of how many are left, well, it is about something like one-quarter of a million Americans and about 500,000 Soviets, just less than that. It is just less in each case than those two numbers, and that reflects, as I say again, the 2.3-to-1 Soviet-to-American advantage in the area of reductions.

Mr. **Mavroules**. You want to reduce that from 700,000 now?

Ambassador **Blackwill**. The reductions on the NATO side, and remember the 700,000 and 900,000 is for all NATO forces, would be about 90,000, which would get down to the 700,000 on the ground forces. On the Warsaw Pact side, of course we have been arguing with them for 12 years about what would be required to get to that number, and the major concession we have now made is to stop that argument and to say all right, you won't talk about data, you have preferred to talk about data for years now.

Indeed, I have said to my Soviet colleagues the quickest way to get them to leave a conversational circle is to mention the word "data," and they head for the door. So what we have said to them is you say that the issue of data has blocked these negotiations for years, and indeed my plenary statement last Thursday was almost entirely filled with quotes from them, from Shevardnadze through their representatives at Vienna, that the major stumbling block was Western insistence on prior data agreement. As I said last Thursday, that stumbling block is now gone.

Now, of course, it is in their capability to introduce new stumbling blocks, should they so choose, but we very much hope they won't.

Mr. **Mavroules**. Finally, Mr. Ambassador, do you feel that they have changed their attitude somewhat, and their positions, relative to verification?

Ambassador **Blackwill**. There has been a very slow evolution in the course of the talks, in which they have moved slightly on the issue of verification, but on the basic principle that the two sides have to be sure that the other side is complying with the agreement, I am afraid they have a good way to go.

Their view is that, essentially, verification of these manpower levels, 1 million on each side, should be done by two means: One, national technical means, which of course can help but cannot count manpower levels, for obvious reasons, and what they call political good will, which I point out to my Soviet colleague is not a serious idea.

Mr. **Mavroules**. I thank you very much.

Mrs. **Byron**. Mr. Courter.

Mr. **Courter**. Thank you.

I have a number of areas of inquiry. I guess there are not a lot of people here, so maybe we can get through them.

Maybe it is better that I go through the areas and you vote them down and try to answer them for me.

I have a question with respect to redeployment of 11,500, and 5,000.

How long would it take the Soviet Union to redeploy their 11,500; and how long would it take the United States to redeploy the 5,000?

The second area of inquiry is, do you know what is going to happen to the 5,000 deployed American troops?

Do we have room to station them in the United States?

Do we have barracks where they can go, and do we have facilities where they can stay?

Or does this mean that they will be phased out and our total troop level is going to be reduced by 5,000?

It is my understanding that the Soviet Union and the United States cannot agree as to the existing level of troops between both sides, and I understand that we are quite confident, very confident, that we are correct as to the Soviet levels.

There is no disagreement on U.S. levels. The disagreement is on the Soviet levels.

We are convinced that we are correct; and assuming that we are correct, because we can count, and we have reliable information, the Soviet Union is lying to us about their levels. I am just wondering when the 11,500 troop reduction level that we are asking the Soviet Union to go ahead with—I guess the question is this:

Since we are saying their levels are at this number, and they disagree, and how we are saying reduce them to 11,500, and if we disagree, where are we?

If we are not satisfied with their reduction of 11,500, where do we go from there?

What do we do?

Does our proposed agreement to say that then if we are not satisfied that unilaterally we reinstate the 5,000?

I suppose I am also concerned about the margin of error. Is the 11,500 within the margin of error, and if so, how do we know whether reducing any of their troops, and if they do move troops out, are we going to have great confidence that we don't move them back in?

Those are my general concerns about this.

I am also wondering if it is such a good proposal; for example, the United States' proposal, not making sure that both sides agree as to what the existing levels are now, but satisfying basically to the Soviet position of ambiguity with regard to the levels, but nevertheless a reduction, if that is a good idea, why wasn't it made 10 years ago?

Why is it such a good idea today, and not yesterday?

Those are the kind of areas that I would like you to elaborate on.

Ambassador **Blackwill**. Let me go through them and then if you want to follow, please interrupt and have a dialog. I think those are very good questions incidently, quite acute questions. And all of them we thought quite a lot about, both in Washington and then in our deliberations within the alliance before we decided to proceed last week.

On the issue of redeployment and reintroduction, there is no question whatsoever that Soviets can reintroduce their forces into the reductions area much more quickly than we can.

Incidently, you may be interested. This issue of geography, which of course, is a primary one for any military planner, is absolutely denied by my Soviet colleague, who says despite the fact that their forces are just across the Polish border in the Western military districts, that they have no advantage at all in the reintroduction of forces into the region.

In that situation you look at someone quizzically, and wonder what sort of fool they think you are. But they have argued that consistently.

On the question of what happens to 5,000 U.S. forces, the proposal now by both sides suggests that they would be returned to the homeland, but not deployed in a way which would threaten other participating states.

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Our concern is, for example, that they not go out of the reductions area and on to the Soviet-Turkish border, or indeed, on the Norwegian borders, to threaten our friends on the flanks.

With respect to the United States, it is our very strong conviction that these forces have to remain in active service, and that they would come back to the United States and arrangements would be made for them. That it would not be appropriate to take these forces out of service.

On the third point——

Mr. COURTER. On that if I may?

Ambassador BLACKWILL. Yes, please.

Mr. COURTER. You obviously assume we are given assurance that we have the physical capability of absorbing 5,000 additional troops.

Ambassador BLACKWILL. It is my understanding that the Joint Chiefs of Staff believe that can be done, should we reach that moment.

On the issue of force levels, I think you put it very well, that they have been misrepresenting the figures from the beginning. Our judgment on the 230,000, we would not argue that it is not off by a bit, because obviously trying to verify manpower levels is a complicated matter, but we are sure that disparity is well over 200,000, and there is really no doubt in our minds about that.

On the question of reintroducing the 11,500 Soviet forces, first of all we would try to deal with the issue of insuring that they actually leave the area of reductions by permanent entry-exit points, and we would watch them go.

Let me just make vivid again the difference between our approach to verification and theirs, under their approach, when these United States and Soviet forces would leave, observers would come just before they left, to the area where they are departing from the reduction zone, and then watch them go, but then leave.

So, as I said to my Soviet counterpart, they go out with the band playing and marching along, we leave and they could come back with the band playing marching along.

We would insist on watching them go. But there is no question that without the kind of certification regime that we have in mind, we would have to worry a great deal about the reintroduction of either those troops or other troops, which would violate the no-increase commitment.

Finally, on the issue, which again, I think, is an acute question, if I may say, why is this a good idea if it wasn't a good idea for 12 years, let me say that I think the answer to that has to do with the phase of East-West relations, and our desire to do everything possible to in this negotiation and others, to find a way to reach a reasonable agreement with the East, which is consistent with our own national security.

The East has said that for years, and years, the principal impediment to agreement was prior data. That no longer is an impediment.

We believe that the package we put forward, introducing its verification provisions, fully protects our national security. But we also believe that without that set of verification provisions, it would not do so, and we shall now see when the Soviet Union, which has professed interest in reaching an agreement in these negotiations for more than a decade is, in fact, interested in reaching an agreement, and as they deliberate this in Moscow, I, for one, can't predict how they will come out, but I believe that if they come out negatively after this major Western concession, then it will be clear to everyone what the Soviet real approach to this negotiations is.

Mr. COURTER. The response—I assume you have gotten no official response.

Ambassador BLACKWILL. That is correct.

Mr. COURTER. But we certainly have gotten an unofficial response and that has been pretty negative, has it not?

Ambassador BLACKWILL. That is correct.

Mr. COURTER. What does the Soviet Union politically say, and informally not officially say?

Are they concerned about the verification measures?

Ambassador BLACKWILL. Yes.

Mr. COURTER. They can't object about anything else because it is basically their position; is it not?

Ambassador BLACKWILL. There are two issues which they object to informally. They were very careful even though they were somewhat negative. They stated that this is not our official response to this NATO initiative, but they proceeded to highlight two things.

One was verification, and they talked about the need for verification based on political goodwill. Incidentally, I would say that over the months since I arrived in Vienna, and before the Geneva summit in discussions with my Soviet colleague, I felt that perhaps he was listening to different media than myself. At that time I didn't see a great deal of political goodwill between East and West on which one could base any degree of trust.

And the second thing they have complained about is the exclusion of armament.

Perhaps I might say a little bit more about that. What they would like essentially is to freeze the level of armaments in the area of reduction.

Now we have really two objections to that. In the first place, that is an immensly complicated subject, and indeed, inconsistent with our own expressed desire to reach a rapid agreement in the negotiation.

Trying to compare disparity weapons systems on the two sides and find some way to reach an agreed set of definitions, if nothing else, would take years.

Second, of course, they would like to freeze the armaments, because in the major weapons systems in the area, tanks, APC's, mobile fixed artillery, attack helicopters and the rest they have anywhere from a 2-to-1 to 4-to-1 advantage which one assumes is related to their desire to freeze the NATO numbers. So those have been their two complaints.

What we have said to them on verification is that all we want is to be sure we can verify compliance with the treaty. Nothing could be a more reasonable position, on our armaments that we don't say that we will never discuss this, but that in this phase of the negotitions, and in order to reach a rapid conclusion, we should simply allow the two sides to deal with armaments in any way they would like, so that means with the United States we could either leave the armaments there in a sort of POMCUS arrangement, we could take them back to the United States if we wished, and they could do the same.

Mr. STRATTON. Thank you, Madam Chairwoman.

Mr. Ambassador, it is certainly nice to see you back here. We appreciate your hospitality and courtesies when we were in Vienna a few weeks ago.

Do I understand that this proposal, which you indicate has two significant points, one that there will be initial United States and Soviet ground force reductions, and that these reductions would then be followed by a no increase commitment covering the forces in Central Europe, all participants in the MBFR negotitions?

Have these two points been agreed to by the Soviet, do I take it?

Ambassador BLACKWILL. Yes, that is part of their February proposal, that framework.

Now, on the first point, they have different numbers than we have. Their numbers are 20,000 or 13,000, since they have not agreed that our judgment of the ratio between the forces is accurate.

But yes, they propose an initial United States-Soviet reduction, and a no-increase commitment on the part of the rest of the participating states.

Those are two of the 16 points which I mentioned in my statement and which are attached to the statement you have, on which the two sides now agree.

Mr. STRATTON. The only thing that disturbs me a little bit is that this is something that NATO has advanced in an effort to try to, as you indicated, demonstrate our goodwill and willingness to cooperate, and then when you come down to the bottom line, after the discussion, the Soviet delegates say that this really has not advanced the cause of disarmament, and that it doesn't inspire optimism, and doesn't contribute to the achievement of a mutually acceptable agreement.

It seems to me that this harks back to the idea that they will be happy to entertain any agreement or any concession that we are willing to make, but after we have made it, then they grumble that it is not enough.

Is this the same kind of pattern that has attended these negotiations in the past?

Ambassador BLACKWILL. Well, I think I have to say that to this point you are absolutely right. Their unofficial reaction is precisely what you said, and I might, in fact, describe a moment in my conversation with Eastern colleagues, when we had laid out this proposal with there major concessions, and essentially said we can accept your framework, we will put data aside, and all the rest.

They really couldn't take yes, for an answer, and they were very negative. I asked whether there is no one other side of the table, given what we have just done, who can bring themselves to say one positive thing about this?

And no one could.

Now, that may have only been a preliminary and instinctive reaction on the part of the delegation, which may well have been without instructions. And what I can say is that we hope very much, as they deliberate about this in Moscow, that they will have something other than what I think you have correctly described as their traditional approach to this negotiation, which is that they would be willing to accept any concessions we make, and hope that one concession will be followed by another until we agree entirely to their position.

I very much hope that is not the case, but I think it will be apparent now, given what NATO has done in the last week, it will be apparent whether they are interested, in an equitable agreement in these negotiations or not, and now I think really the spotlight is on Moscow.

I might just say that this is a negotiation, as you know, and we talked about this when you all were in Vienna, which is of considerable importance to the Europeans, following Thursday's preliminary in which there were about 50 journalists, very uncharacteristic I might say for the Vienna talks, 50 journalists in the press conference, this was on the front page of every newspaper in Europe, and I believe it was generally characterized as I have just done, that NATO has made a major concession, and we will now see when the East is really, is truly interested in agreement.

Mr. STRATTON. Have the Soviets ever advanced any particular ideas or concessions of their own?

I remember it seems to me that we at one point agreed to eliminate 1,000 strategic nuclear tactical weapons, and later on I think we agreed to remove another 1,700 tactical nuclear weapons.

Have they ever come up with a suggestion that they might knock out two or three tank armies, just to be agreeable?

Ambassador BLACKWILL. Well, in 1979 they said that they had withdrawn 20,000 troops from the German Democratic Republic. They did it at the time to influence our INF deliberations which they were unsuccessful in doing.

Since that time they have occasionally episodically tried to take credit for that in the MBFR negotiations.

We told them there are two problems. First of all we are not really sure they took them out; and second, even if they did, it had nothing to do with our negotiations.

They shouldn't try to take credit for it. It is also possible that some of those forces ended up in Afghanistan, as a matter of fact.

I think typical of Soviet negotiating tactics, the simple answer to your question is, no, they haven't, and indeed, perhaps it is even worse than that, because on a couple of issues, one which they showed some flexibility in previous years, in their proposal, they regressed again.

So I think that—and I think this is implicit in your question, Congressman—that we really have to be patient now.

We have gone the extra mile. We really now have put to them a position which essentially says we agree with your approach to negotiations, consistent with adequate verification.

If they find a way, and, of course, as I said before they can find a way to raise new obstacles or to assert that this really isn't a concession on our part, then I think it will be apparent to all fair minded people on both sides of the Atlantic where the responsibility lies for continuing impasse.

Mr. **Stratton**. This might be something that if they don't make any positive reaction, we would take advantage of Mr. Gorbachev's visit in the spring and get him to see if he can't make some action on the Soviet side in these talks.

Ambassador **Blackwill**. Well, as I said, I very much hope that now, between the rounds while our Soviet counterparts are back to Moscow. I hope back there will be new impetus. Although we really don't know, as you know, anything about their decisionmaking. I would guess that the negotiation hasn't gone to the political level for many years. We have very much hope that now it will go to the political level, and maybe some of the incrustation that has grown up over this decade will be broken by the new political leadership in the Soviet Union. But we will just have to wait to see.

Mr. **Stratton**. Thank you very much.

Mrs. **Byron**. Mr. Ambassador, let me ask you a question that has been on my mind for a very long period of time.

Would you be surprised to see any change in the Soviet delegation when they return at the end of January?

Ambassador **Blackwill**. Well, my Soviet counterpart, Ambassador Mikalov, has been ambassador in Vienna for 4½ years.

Mrs. **Byron**. That is right.

Ambassador **Blackwill**. And all I can say is that we really never know when the Soviet delegation goes away who is going to turn up when they come back, until they actually do arrive on a train a few days before the negotiations. So I really can't speculate on whether he will continue his assignment or they will find something else for him to do.

Mrs. **Byron**. You say that in the proposals for a reduction, 90 percent will be units; 10 percent in individuals.

Would that not affect our coverage of Europe, if an air force unit per se, would be moved in totally?

Ambassador **Blackwill**. Well, the 90 percent proposition is one which, of course, we insured was consistent with the way that the Joint Chiefs of Staff would try to manage these withdrawals. It turns out that probably in the interest of efficiency, the JCS would prefer to take these reductions in units anyway, rather than thinking out across several units.

It is also true that if one had to reintroduce these units, because of one reason or another, especially Soviet noncompliance with the agreement, it would be easier to reintroduce them.

There is one point I think you have put your finger on an important issue, and I want to emphasize this.

We are willing to test Soviet desire for an agreement in these negotiations, and that is what we have just done, and provided that we can have some confidence about their compliance, then we are willing to proceed.

However, if we do apply the verification measure, and if we discover that they are not complying with the elements of the agreement, then we have protected ourselves, because under the idea that we have, the agreement would automatically lapse at the end of the verification period, and would have to be renewed on the basis of consensus by all the participating states. So if at the end of the 3-year verification period we were to discover that the Soviets were not in compliance, then the agreement would come to an end.

Mrs. **Byron**. Let me ask on the no-increase provision, doesn't that lead us to a potential future of bickering? How would the suspected violations of that be handled?

Ambassador **Blackwill**. When we were deliberating about this, we thought a lot about just that question, because obviously we could not find ourselves in a situation in which we charged a violation, they denied it, and then you had your technicians arguing about it for the next several years. The criterion we applied to this issue was that in the event the Soviets decide not to comply with the terms of the agreement that they have signed, what verification regime is required in order to provide politically persuasive evidence to follow, such as yourselves and to the publics in North America and in Western Europe that they are not complying. We are persuaded that the combination of information exchange in which they have to give us a disaggregated (broken down to battalion level) list of all their forces, locations, numbers, subordinations in the reductions area, and the number of inspections, that is to say 30 per year, that will give us politically decisive evidence, if in fact they are not in compliance with the terms of an agreement that they would have signed.

Mrs. **Byron**. The Eastern proposal for February 1985, the basic provisions of that proposal, could you review those just briefly?

Ambassador **Blackwill**. Yes. First they called for United States-Soviet withdrawals, 20,000 and 13,000, a no-increase commitment on forces, and as I say, we have accepted both those propositions, but also a no-increase commitment on armaments, which as I mentioned before, we don't believe would contribute to peace and security in Europe.

And finally, a set of very weak verification measures—almost nonexistent verification measures. And again, during these months when we have been discussing their proposal with them, they had hinted from time to time that they would show flexibility, if we were only flexible in agreeing to proceed on the basis of their February framework.

Well, we have now agreed to proceed on the basis of their February framework, and we will see now whether the flexibility which they have hinted to us for months will, in fact, occur after they have had a chance to deliberate in Moscow.

Mrs. **Byron**. Mr. Ray, do you have any further questions?

Mr. **Ray**. No.

Mrs. **Byron**. Mr. Klein, do you have any questions?

Mr. **Klein**. I was wondering, Mr. Ambassador, now that we have dropped our position on data, if the Soviets find this entire thing unacceptable and negotiations go on, will we be in a position to return to our previous position on data, or will they, do you believe, accept this as a new plateau, and try to ratchet us down a little further on our position?

Ambassador **Blackwill**. Well, let me say that they would certainly hope that this is a new plateau, and one couldn't depart from it, and one would have to see how the negotiations go. But I would only note that in the course of the negotiations, on several occasions they have made minor concessions, and two rounds later taken them back.

We are putting forward this proposal on the basis of a desire to make progress in the negotiation, and we would have to consider how to proceed, if they are utterly negative and unreasonable in response, and that would be, of course, a subject of discussion between ourselves and our NATO friends about what to do next.

But, of course, we all very much hope that is not going to be the case, and that they will come back at the end of January willing to intensely negotiate along within the framework of their own proposal. In other words, to take yes for an answer within the framework of their own proposal. We hope that will be the case. We will have to wait and see.

Mr. **Klein**. Thank you.

Mrs. **Byron**. Dr. Mansfield.

Dr. **Mansfield**. No questions.

Mrs. **Byron**. Mr. Ambassador, I want to thank you once again for taking the time out of your schedule to brief us in depth this morning on where we stand. We look forward toward progress at the end of January when once again you go back to the negotiating table. In the meantime, have a pleasant Christmas.

Ambassador **Blackwill**. Thank you very much, Madam Chairman. Let me just say, as I mentioned before, we profited very much from this panel's visit during the last round, and I hope that sometime after the next round starts, if you all find it convenient, you might return to Vienna, because it will be a particularly interesting period in the negotiations. So if your travel schedules and other obligations permit, I would very much like to see you all there.

Mrs. **Byron**. I have already had several members of the panel make that request, and we will look at their schedules.

Ambassador **Blackwill**. Good.

Mrs. **Byron**. You go back on the 30th of January until when?

Ambassador **Blackwill**. And we will go on for about 7 weeks after that, so it is early to mid-March.

It is good to be here, Madam Chairman.

Ambassador **Blackwill**. Thank you.

[Whereupon, at 11:25 p.m., the panel adjourned.]

## APPENDIX A

## House Calendar No. 53

99th CONGRESS
1st Session

# H. J. RES. 3

[Report No. 99–221]

To prevent nuclear explosive testing.

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## IN THE HOUSE OF REPRESENTATIVES

January 3, 1985

Mr. Bedell (for himself, Mr. Leach of Iowa, and Mr. Markey) introduced the following joint resolution; which was referred to the Committee on Foreign Affairs

July 24, 1985

Additional sponsors: Mr. Zschau, Mr. Addabbo, Mr. Coughlin, Mr. Hamilton, Mrs. Schneider, Mr. Downey of New York, Mr. Dicks, Mr. AuCoin, Mr. Aspin, Mr. Smith of Iowa, Mr. Mavroules, Mr. Jeffords, Mr. Green, Mr. Studds, Mr. Barnes, Mr. Wolpe, Mr. Miller of California, Mr. Brown of California, Mr. Frank, Mr. Edwards of California, Mr. Stark, Mr. Beilenson, Mr. Evans of Illinois, Mr. Hall of Ohio, Mr. Clay, Mr. Crockett, Mr. Gejdenson, Mr. Edgar, Mr. Lowry of Washington, Mr. Dorgan of North Dakota, Mr. Torricelli, Mr. Berman, Mrs. Boxer, Mr. Garcia, Mr. Dellums, Mr. Leland, Mr. Roybal, Mr. Kastenmeier, Mr. Towns, Mr. Morrison of Connecticut, Mr. Rahall, Mrs. Collins, Mr. Bates, Mr. Seiberling, Mr. Weiss, Mr. Bonior of Michigan, Mr. Mitchell, Mr. Fazio, Ms. Kaptur, Mr. Synar, Mr. Ford of Tennessee, Mr. Lehman of Florida, Mr. Owens, Mr. Martinez, Mr. Dymally, Mr. Wyden, Mr. Lundine, Mr. Penny, Mr. Walgren, Mr. Dwyer of New Jersey, Mr. Fauntroy, Mr. McKinney, Mr. Ford of Michigan, Mr. Sabo, Mr. Rodino, Mr. Mineta, Mr. Durbin, Mr. Bosco, Mr. Conyers, Mr. Russo, Mr. Moakley, Mr. Vento, Mr. Panetta, Mr. Udall, Mr. Wirth, Mr. Hughes, Mr. Kildee, Mr. Fish, Mrs. Burton of California, Mr. Feighan, Mr. Pease, Mr. Lehman of California, Mr. Levine of California, Mr. Savage, Mr. Weaver, Mr. Mrazek, Mr. Wheat, Mr. Hoyer, Mr. Oberstar, Mrs. Schroeder, Mr. Richardson, Mr. Schumer, Mr. Glickman, Mr. Traxler, Mr. Waxman, Ms. Oakar, Mr. Fascell, Mr. Levin of Michigan, Mr. Dixon, Mr. Daschle, Mr. Matsui, Mr. Moody, Mr. Neal, Mr. Kostmayer, Mr. Foglietta, Mr. Sikorski, Mr. Howard, Mr. Bonker, Mr. Smith of Florida, Mr. Ackerman, Mr.

LANTOS, Mr. STOKES, Mr. MCHUGH, Mr. AKAKA, Mrs. KENNELLY, Mr. LAFALCE, Mr. ALEXANDER, Mr. SOLARZ, Mr. GRAY of Pennsylvania, Mr. TAUKE, Ms. SNOWE, Mr. OBEY, Mr. MURPHY, Mr. SUNIA, Mr. FAWELL, Mr. JACOBS, Mr. BOLAND, Mr. SWIFT, Mr. MCKERNAN, Mr. BOEHLERT, Mr. MCCLOSKEY, Mr. WISE, Mr. FLORIO, Mr. HAYES, Mr. OLIN, Mr. SCHEUER, Mr. GIBBONS, Mr. RANGEL, Mr. WILLIAMS, Mr. FOWLER, Mr. FOLEY, Mr. GEPHARDT, Mrs. JOHNSON, Mr. PERKINS, Mr. GUARINI, Mr. STAGGERS, Mr. ATKINS, Mr. GALLO, Mr. YATES, Mr. FROST, Mr. BOUCHER, Mr. KOLTER, Mr. CARPER, Mr. BRUCE, Mr. SHARP, Mr. COELHO, Mr. HEFTEL of Hawaii, Mr. ROSE, Mr. JONES of Tennessee, Mr. EARLY, Mr. ST GERMAIN, Mr. JONES of North Carolina, Mrs. BOGGS, Mr. COOPER, Mrs. LONG, Mr. TORRES, Mr. HAWKINS, Mr. KLECZKA, Mr. HENRY, Mr. BIAGGI, Mr. YATRON, Mr. DONNELLY, Mr. HERTEL of Michigan, Mr. TRAFICANT, Mr. DERRICK, Mr. PETRI, Mr. GILMAN, Mr. PURSELL, Mr. MANTON, Mr. STRANG, Mr. GUNDERSON, Mr. BUSTAMANTE, Mr. GONZALEZ, Mr. ROE, Mr. MOLLOHAN, Mr. SLATTERY, Mr. MACKAY, Mr. NOWAK, Mr. LUKEN, Mr. VOLKMER, Mr. ECKART of Ohio, Mr. WHITLEY, Mr. APPLEGATE, Mr. PEPPER, and Mr. COYNE

July 24, 1985

Referred to the House Calendar and ordered to be printed

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# JOINT RESOLUTION

To prevent nuclear explosive testing.

Whereas the United States is committed in the Limited Test Ban Treaty of 1963 and in the Non-Proliferation Treaty of 1968 to seek to achieve the discontinuance of all test explosions of nuclear weapons for all time;

Whereas a comprehensive test ban treaty would promote the security of the United States by constraining the United States-Soviet nuclear arms competition and by strengthening efforts to prevent the proliferation of nuclear weapons;

Whereas the Threshold Test Ban Treaty was signed in 1974 and the Peaceful Nuclear Explosions Treaty was signed in 1976, and both have yet to be considered by the full Senate for its advice and consent to ratification;

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Whereas the entry into force of the Peaceful Nuclear Explosions Treaty and the Threshold Test Ban Treaty will ensure full implementation of significant new verification procedures and so make completion of a comprehensive test ban treaty more probable;

Whereas a comprehensive test ban treaty must be adequately verifiable, and significant progress has been made in methods for detection of underground nuclear explosions by seismological and other means;

Whereas, at present, negotiations are not being pursued by the United States and the Soviet Union toward completion of a comprehensive test ban treaty; and

Whereas the past five administrations have supported the achievement of a comprehensive test ban treaty: Now, therefore, be it

*Resolved by the Senate and House of Representatives of the United States of America in Congress assembled,* That at the earliest possible date, the President of the United States should—

(1) request advice and consent of the Senate to ratification (with a report containing any plans the President may have to negotiate supplemental verification procedures, or if the President believes it necessary, any understanding or reservation on the subject of verification which should be attached to the treaty) of the Threshold Test Ban and Peaceful Nuclear Explosions Treaties, signed in 1974 and 1976, respectively; and

(2) propose to the Soviet Union the immediate resumption of negotiations toward conclusion of a verifiable comprehensive test ban treaty.

In accordance with international law, the United States shall have no obligation to comply with any bilateral arms control agreement with the Soviet Union that the Soviet Union is violating.

## APPENDIX B

I

99th CONGRESS
1st Session

# H. R. 3100

To provide for a comprehensive bilateral and verifiable freeze between the United States and the Soviet Union on the testing, production, and deployment of nuclear weapons systems.

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## IN THE HOUSE OF REPRESENTATIVES

July 30, 1985

Mr. Markey (for himself, Mr. Mavroules, Mr. McKinney, Mrs. Schneider, Mr. Addabbo, Mr. St Germain, Mr. Edgar, Mrs. Burton of California, Mr. Yates, Mr. Hayes, Mr. Roybal, Mr. Leland, Mr. Frank, Mr. Oberstar, Mr. Kastenmeier, Mr. Owens, Mr. Boland, Mr. Miller of California, Mr. Dixon, Mr. Lehman of Florida, Mr. Martinez, Mr. Wheat, Mr. Studds, Mr. Towns, Mr. Moakley, Mr. Ford of Michigan, Mr. Mrazek, Mr. Torres, Mr. Rahall, Mrs. Kennelly, Mr. Kostmayer, Mr. Downey of New York, Mrs. Boxer, Mr. Evans of Illinois, Mr. Savage, Mr. Fauntroy, Mr. Morrison of Connecticut, Mr. Atkins, Mr. Weaver, Mr. Kildee, Mr. Schumer, Mr. Dellums, Mr. Weiss, Mr. Mitchell, Mr. Edwards of California, Mr. Bates, Mr. Durbin, Mr. Torricelli, Mr. Rodino, Mr. Scheuer, Mr. Feighan, Mr. AuCoin, Mr. Vento, Mr. Panetta, Mr. Lehman of California, Mr. Gejdenson, Mr. Mineta, Mr. Brown of California, Mr. Sabo, Mr. McHugh, Mr. Matsui, Mr. Ackerman, Mr. Levine of California, Mr. Jacobs, Mr. Sikorski, Mr. Carr, Mr. Clay, Mr. Udall, Mrs. Collins, Ms. Kaptur, Mr. Howard, Mr. LaFalce, Mr. Barnes, Mr. Conyers, Mr. Williams, Mr. Bruce, Mr. Crockett, Mr. Walgren, Mr. Garcia, Mr. Bosco, Mr. Biaggi, Mr. Lowry of Washington, Mr. Bonior of Michigan, Mr. Rostenkowski, Mr. Rangel, Mr. Manton, Mr. Russo, Mr. Lantos, Mr. Moody, Mr. Waxman, Mr. Wirth, and Mr. Ford of Tennessee) introduced the following bill; which was referred jointly to the Committees on Foreign Affairs, Rules, and Armed Services

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# A BILL

To provide for a comprehensive bilateral and verifiable freeze between the United States and the Soviet Union on the testing, production, and deployment of nuclear weapons systems.

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,*

**SECTION 1. SHORT TITLE.**

This Act may be cited as the "Comprehensive Nuclear Weapons Freeze and Arms Reduction Act of 1985".

**SEC. 2. FINDINGS.**

The Congress makes the following findings and declarations:

(1) The greatest challenge facing human civilization is to prevent the occurrence of nuclear war by accident or design.

(2) The effects of nuclear explosions directed at military targets would not be confined to these targets and would inevitably cause catastrophic damage to human society and the natural environment on a scale unprecedented in history.

(3) The testing, production, and deployment of nuclear weapons systems with the accuracy and explosive power to destroy an adversary's heavily protected missiles and command centers heightens mutual fears of a "first strike" and fosters a preemptive nuclear warfighting mentality which is dangerously removed from the real-life consequences of nuclear explosions.

(4) A comprehensive, mutual, and verifiable nuclear weapons freeze would halt new destabilizing developments in nuclear weaponry, diminish fears of preemptive nuclear attack, improve the deterrent effectiveness of existing nuclear forces by enhancing their survivability, and put an end to the wasteful and, in the eyes of the global community, immoral competition in nuclear armaments.

(5) National verification techniques, operating in conjunction with International Atomic Energy Agency safeguards on civilian nuclear facilities and supplemented by negotiated cooperative procedures for the inspection of ambiguous events and facilitates, would be sufficient to detect any change in the status of Soviet nuclear forces during a comprehensive freeze that would represent a threat to our national security.

(6) An immediate, mutual pause by the United States and the Soviet Union in the testing and deployment of nuclear weapon systems will break the momentum of the arms race, build confidence on both sides, and facilitate negotiations to halt and reverse the arms race.

## SEC. 3. NEGOTIATIONS CONCERNING THE COMPREHENSIVE FREEZE.

(a) CALL FOR IMMEDIATE FREEZE NEGOTIATIONS.—It is the sense of the Congress that the President should immediately invite the Soviet Union to enter into serious negotiations with the United States in order to reach agreement at the earliest possible date on the terms of a comprehensive freeze.

(b) NOTIFICATION TO SOVIET UNION OF U.S. INTENTIONS TO ENGAGE IN A BILATERAL HALT IN TESTING, PRODUCTION, AND DEPLOYMENT.—The President should communicate to the Soviet Union the intention of the United States to engage in a bilateral halt, in accordance with this Act, in the testing, production, and deployment of nuclear weapons systems.

## SEC. 4. NEGOTIATIONS CONCERNING NUCLEAR WEAPONS REDUCTIONS.

It is the sense of the Congress that—

(1) both during and after negotiations for a comprehensive freeze, the President should pursue mutual, steady, annual, percentage reductions in nuclear arsenals; and

(2) a comprehensive freeze is entirely consistent with, and an essential component of, mutual stabilizing reductions in nuclear forces.

## SEC. 5. CONGRESSIONAL OVERSIGHT OF VERIFICATION PROCEDURES.

(a) REQUIREMENT FOR HEARINGS ON VERIFICATION PROCEDURES.—The Permanent Select Committee on Intelligence of the House of Representatives and the Select Committee on Intelligence of the Senate shall each begin oversight hearings on verification procedures for the comprehensive freeze.

(b) PARTICIPATION BY OTHER COMMITTEES IN HEARINGS.—

(1) SENATE.—The Select Committee on Intelligence of the Senate shall allow members of the Senate Committee on Armed Services, members of the Senate Committee on Foreign Relations, and members of the Subcommittee on Defense of the Senate Committee on Appropriations to participate in its hearings pursuant to subsection (a).

(2) HOUSE OF REPRESENTATIVES.—The Permanent Select Committee on Intelligence of the House of Representatives shall allow members of the House Committee on Armed Services, members of the House Committee on Foreign Affairs, and members of the Subcommittee on Defense of the House Committee on Appropriations to participate in its hearings pursuant to subsection (a).

(c) REQUIREMENT FOR REPORT ON VERIFICATION PROCEDURES.—Following the hearings pursuant to subsection (a), but no later than 6 months after the date of enactment of this Act, the Permanent Select Committee on Intelligence of the House of Representatives and the Select Committee on Intelligence of the Senate shall each submit a report to their respective House on the adequacy of United States monitoring systems and existing agreed procedures for verifying Soviet compliance with the comprehensive freeze.

(d) INFORMATION TO BE INCLUDED IN REPORT.—The report required by subsection (c), which shall be prepared in both a classified and an unclassified form, shall include—

(1) an assessment of the nature and extent of Soviet activities and installations involved in the testing, production, and deployment of nuclear weapons systems;

(2) an assessment of current United States capabilities to monitor changes, that would pose a threat to our national security, in the status of Soviet nuclear forces under the comprehensive freeze; and

(3) an assessment of additional monitoring systems and cooperative procedures that may be required to increase monitoring confidence of certain aspects of a comprehensive freeze.

### SEC. 6. OPERATIONAL PLAN FOR UNITED STATES IMPLEMENTATION OF THE COMPREHENSIVE FREEZE.

(a) PREPARATION OF OPERATIONAL PLAN.—The Director of the United States Arms Control and Disarmament Agency shall immediately begin preparing an operational plan for implementation by the United States of the comprehensive freeze.

(b) CONSULTATION.—In preparing the plan required by subsection (a), the Director shall consult with the Secretary of Defense, the Secretary of Energy, and other appropriate federal officials.

(c) REPORT ON OPERATIONAL PLAN.—No later than 9 months after the date of enactment of this Act, the Director shall submit to the Congress a report on operational plan prepared pursuant to subsection (a). This report shall specify—

(1) procedures for the cessation of activities and closure or conversion of facilities affected by the comprehensive freeze;

(2) a program for the retraining and re-employment of Government and defense industry personnel directly affected by the termination of nuclear weapons-related activities; and

(3) a program of economic adjustment assistance for those communities whose local economy may be ad-

versely affected by the sudden shift in the pattern of Government expenditure.

### SEC. 7. SEMIANNUAL REPORTS ON FREEZE NEGOTIATIONS, SOVIET COMPLIANCE, AND VERIFICATION.

(a) REQUIREMENT FOR SUBMISSION OF REPORTS.—At the times specified in subsection (b), the President shall submit to the Congress a report, in both classified and unclassified versions, which describes in detail—

(1) the status of United States and Soviet efforts to negotiate a comprehensive freeze;

(2) Soviet military activities during the preceding 6 months relating to the testing, production, and deployment of nuclear weapons systems; and

(3) any uncertainties concern verification of the comprehensive freeze, the status of efforts to reduce those uncertainties, and the national security implications of those uncertainties.

(b) TIMES FOR SUBMISSION OF REPORT.—The first report pursuant to subsection (a) shall be submitted no earlier than 7 months and no later than 8 months after the date of enactment of this Act, and subsequent reports shall be submitted at 6-month intervals thereafter.

### SEC. 8. FUNDING RESTRICTIONS ON TESTING, PRODUCTION, AND DEPLOYMENT OF NUCLEAR WEAPONS SYSTEMS.

(a) RESTRICTIONS CONDITIONED ON SOVIET WILLINGNESS TO OBSERVE A BILATERAL HALT IN TESTING, PRODUCTION, AND DEPLOYMENT.—The restrictions contained in this section shall take effect only if, during the 30-day period beginning on the date of enactment of this Act, the Government of the Soviet Union communicates to the President that the Soviet Union will join with the United States in observing a bilateral halt in the testing, production, and deployment of nuclear weapons systems.

(b) RESTRICTIONS ON TESTING AND DEPLOYMENT.—

(1) IN GENERAL.—Appropriated funds may not be obligated or expended for the testing or deployment of nuclear weapons systems, unless the Congress expressly provides otherwise in a joint resolution enacted pursuant to section 10 following a Presidential request pursuant to section 9.

(2) EFFECTIVE DATES OF RESTRICTIONS ON TESTING AND DEPLOYMENT.—

(A) IN GENERAL.—Except as provided in subparagraph (B), the restrictions on testing and deployment contained in paragraph (1) shall take effect 30 days after the date of enactment of this Act.

(B) Special Rule for Certain Nuclear Missiles.—The restrictions contained in paragraph (1) shall not take effect with respect to the testing and deployment of nuclear missiles with a range of 600 kilometers or less until one year after the date of enactment of this Act.

(c) Restriction on Production.—

(1) In General.—Appropriated funds may not be obligated or expended for the production of nuclear weapons systems, unless the Congress expressly provides otherwise in a joint resolution enacted pursuant to section 10 following a Presidential request pursuant to section 9.

(2) Effective Date of Restriction on Production.—The restriction on production contained in paragraph (1) shall take effect one year after the date of enactment of this Act.

(d) Interpretation of Provisions.—The restrictions contained in this section—

(1) apply with respect to any funds appropriated or otherwise made available by the Congress for any fiscal year, including any funds which have been obligated but not expended;

(2) apply notwithstanding any other provision of law, including any Act authorizing the appropriation of

funds for the testing, production, or deployment of nuclear weapons systems and any Act or joint resolution appropriating funds for the testing, production, or deployment of nuclear weapons systems; and

(3) do not preclude the use of funds for necessary expenses resulting from the suspension or cancellation of existing contracts relating to the testing, production, or deployment of nuclear weapons systems.

## SEC. 9. PRESIDENTIAL REQUEST FOR FUNDING FOR NUCLEAR WEAPONS SYSTEMS.

(a) SUBMISSION OF REQUEST.—Subject to subsection (b), the President may request that the Congress remove, in whole or in part, funding restrictions contained in section 8 on the testing of nuclear weapons systems, on the production of nuclear weapons systems, and on the deployment of nuclear weapons systems.

(b) CERTIFICATION WHICH MUST ACCOMPANY REQUEST.—A request may be made pursuant to subsection (a) only if the President certifies to the Congress that—

(1) the Soviet Union has failed to demonstrate a restraint with respect to nuclear weapons systems which corresponds to the restraint being shown by the United States pursuant to this Act; or

(2) continuation of the funding restrictions would cause significant and irreparable damage to the national security of the United States.

(c) TIME FOR SUBMISSION OF REQUEST.—Except in exceptional circumstances, a request pursuant to subsection (a) should not be submitted to the Congress before the first semiannual report is submitted pursuant to section 7.

### SEC. 10. REQUIREMENT FOR EXPEDITIOUS CONGRESSIONAL ACTION ON PRESIDENTIAL REQUEST FOR FUNDING OF NUCLEAR WEAPONS SYSTEMS.

If the President submits a request pursuant to section 9 for the removal (in whole or in part) of funding restrictions contained in section 8, the Congress shall promptly begin consideration of a joint resolution which would grant that request and shall complete its consideration of that joint resolution (including such amendments as the Congress considers appropriate) no later than 30 days after receiving the request.

### SEC. 11. DEFINITIONS.

(a) DEFINITION OF COMPREHENSIVE FREEZE.—For purposes of this Act, the term "comprehensive freeze" means a bilateral and adequately verifiable halt by the United States and the Soviet Union in all testing, production, and deployment of nuclear weapons systems. Included in a comprehensive freeze would be all weapons systems designed primarily for use in a nuclear conflict.

(b) DEFINITIONS OF TESTING, PRODUCTION, AND DEPLOYMENT OF NUCLEAR WEAPONS SYSTEMS.—The following definitions apply for purposes of this Act:

(1) TESTING.—The term "testing of nuclear weapons systems" means—

(A) the testing of nuclear explosive devices;

(B) the flight testing of nuclear missiles; and

(C) the flight testing against targets in space of anti-satellite (ASAT) and anti-ballistic missile (ABM) weapons.

(2) PRODUCTION.—The term "production of nuclear weapons systems" means—

(A) the operation of facilities for the production of plutonium and highly enriched uranium for use in nuclear explosive devices;

(B) the operation of facilities for the manufacture of nuclear fission and fusion components for nuclear explosive devices;

(C) the operation of final assembly facilities for nuclear explosive devices;

(D) the operation of facilities for the final assembly of strategic bombers.

(E) the operation of facilities for final assembly of missile stages for nuclear missiles;

(F) the operation of facilities for the manufacture of individual stages for nuclear missiles; and

(G) the production of other components dedicated for nuclear weapons systems.

(3) DEPLOYMENT.—

(A) IN GENERAL.—The term "deployment of nuclear weapons systems" means—

(i) the deployment of any new strategic bomber type, or the deployment of any units of an existing strategic bomber type above the number deployed as of the freeze date;

(ii) the deployment of any modification of existing strategic bomber types which would be verifiable by the other nation, unless the modification is primarily for the purposes of safety or deployment of the modification was begun before the freeze date;

(iii) any deployment or modification of ballistic-missile submarines which would cause the aggregate number of missile launch tubes deployed to be greater than the number deployed on the freeze date;

(iv) the deployment of new nuclear missile types, or the deployment of any missiles of an existing nuclear missile type above the number deployed on the freeze date;

(v) the deployment of any launchers for new nuclear missile types, or the deployment of any fixed or mobile launchers for an existing nuclear missile type above the number deployed on the freeze date; and

(vi) the deployment of new types of nuclear explosive devices, or the deployment of any units of an existing type of nuclear explosive device above the number deployed on the freeze date.

(B) CLARIFYING PROVISIONS.—

(i) BALLISTIC MISSILE SUBMARINES.—Subject to the limitations in subparagraph (A)(iii), nothing in subparagraph (A) shall be construed to prevent ballistic missile submarines from being replaced or modified in any way.

(ii) HARDENING OF FIXED MISSILE LAUNCHERS.—Improved hardening of fixed missile launchers shall not be considered to be a deployment of nuclear weapons systems for purposes of subparagraph (A).

(iii) NEGOTIATED REDUCTIONS.—Nothing in subparagraph (A) shall be construed to impede a negotiated agreement on reductions in any nuclear weapons system permitted to be deployed under the definition contained in subparagraph (A).

(c) DEFINITIONS OF OTHER TERMS.—The following definitions apply for purposes of this Act:

(1) NUCLEAR MISSILE.—The term "nuclear missile" means a missile whose primary mission requires it to deliver a nuclear explosive device.

(2) STRATEGIC BOMBER.—The term "strategic bomber" means the following aircraft (which have as their primary mission the delivery of nuclear weapons):

(A) The Soviet Backfire, Bear, Bison, Blackjack, and Fencer aircraft.

(B) The United States B-52, B-1B, FB-111, F-111, and Advanced Technology Bomber aircraft.

(C) Any other aircraft of comparable range-payload equipped with internal bomb bays or external weapon-carrying hard points.

(3) Nuclear Explosive Device.—The term "nuclear explosive device" means any warhead, bomb, or other explosive device which uses fissionable materials.

(4) Existing Type.—The terms "existing nuclear missile type", "existing strategic bomber type", and "existing type of nuclear explosive device" mean a type of missile, bomber, or explosive device that was deployed by the nation as of the freeze date.

(5) New Type.—The terms "new nuclear missile type", "new strategic bomber type", and "new type of nuclear explosive device" mean a type of missile, bomber, or explosive device that was not deployed by the nation as of the freeze date.

(6) Freeze Date.—The term "freeze date" means—

(A) for purposes of negotiations between the United States and the Soviet Union concerning the comprehensive freeze and reductions, the date agreed to for implementation of the comprehensive freeze; and

(B) for purposes of the funding restrictions contained in this Act, the date of enactment of this Act.

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# APPENDIX C

I

99TH CONGRESS
1ST SESSION

# H. R. 3442

To provide for a mutual, simultaneous, verifiable cessation of the testing of nuclear warheads effective on or before January 1, 1986, and for other purposes.

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## IN THE HOUSE OF REPRESENTATIVES

SEPTEMBER 26, 1985

Mrs. SCHROEDER (for herself, Mr. FRANK, Mr. HAYES, Mr. EDWARDS of California, Mr. STUDDS, Mr. DELLUMS, Mr. KOLTER, Mr. LELAND, Mr. FAUNTROY, Mr. WEAVER, Mr. SAVAGE, Mr. MITCHELL, Mr. LOWRY of Washington, Mr. MURPHY, Mr. MRAZEK, Mr. CROCKETT, Ms. KAPTUR, Mrs. BURTON of California, Mr. SEIBERLING, Mr. CLAY, Mr. CONYERS, Mr. WEISS, Mr. KASTENMEIER, Mr. TOWNS, Mr. RAHALL, Mr. LEVINE of California, Mr. VENTO, Mr. BOSCO, Mrs. KENNELLY, Mr. MOODY, Mr. LEHMAN of Florida, Mr. MARTINEZ, Mr. WIRTH, Mr. RANGEL, Mrs. COLLINS, Mrs. BOXER, Mr. OBERSTAR, and Mr. MINETA) introduced the following bill; which was referred jointly to the Committees on Foreign Affairs and Armed Services

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# A BILL

To provide for a mutual, simultaneous, verifiable cessation of the testing of nuclear warheads effective on or before January 1, 1986, and for other purposes.

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,*

### SECTION 1. SHORT TITLE.

This Act may be cited as the "Simultaneous Nuclear Test-Ban Act".

BEST COPY AVAILABLE

## SEC. 2. FINDINGS.

The Congress finds—

(1) that the mutual and simultaneous cessation of the testing of nuclear warheads by the United States and the Soviet Union would give a positive indication of a sincere desire by both nations to end the nuclear arms race;

(2) that such an indication would provide the proper climate for current and future nuclear arms control negotiations; and

(3) that the Soviet Union has declared a cessation on the testing of nuclear warheads beginning on August 6, 1985, to last for a 5-month period and has stated that if the United States joins in the cessation, it will remain in effect indefinitely.

## SEC. 3. SENSE OF CONGRESS.

(a) Cessation of Nuclear Testing.—(1) It is the sense of Congress that the President, before January 1, 1986, should declare that the United States will cease the testing of nuclear warheads and will invite the Soviet Union to meet with the United States to enter into negotiations for the conclusion of a Comprehensive Test Ban Treaty at the earliest possible date.

(2) If such a cessation of the testing of nuclear warheads takes effect, the United States should continue the cessation of the testing of nuclear warheads so long as the Soviet

Union refrains from the testing of nuclear warheads and substantive Comprehensive Test Ban Treaty negotiations are in progress.

(b) RESUMPTION OF COMPREHENSIVE TEST BAN TALKS.—It is the sense of Congress that during a cessation of the testing of nuclear warheads described in subsection (a) the President should actively seek resumption of the comprehensive test ban talks between the United States, Great Britain, and the Soviet Union in order to achieve a Comprehensive Test Ban Treaty.

### SEC. 4. LIMITATION ON USE OF FUNDS.

(a) IN GENERAL.—If the President does not declare a cessation of testing nuclear warheads as described in section 3(a), then during the six-month period beginning on January 1, 1986, no funds appropriated or otherwise made available by Congress may be obligated or expended by the United States for the testing of nuclear warheads.

(b) AUTHORITY IF SOVIET UNION TESTS.—(1) If the President certifies to Congress after January 1, 1986, that the Soviet Union has on or after that date tested a nuclear warhead, then beginning on such date funds may be obligated or expended by the United States for such testing.

(2) The President shall include with any certification under this subsection—

(A) an unclassified report summarizing the basis for the certification; and

(B) a classified report describing in detail the activities of the Soviet Union that are the basis for the certification.

### SEC. 5. VERIFICATION OF CESSATION OF TESTING.

The Congress determines that—

(1) existing national technical means of verification are adequate to provide confidence during the six-month period of the cessation of nuclear testing referred to in section 4(a) that no nuclear test can be conducted that would lead to a military advantage for either participant;

(2) the comprehensive test ban talks referred to in section 3(b) can build upon verification procedures already developed and incorporated in previous treaties and agreements to provide long-term mutually acceptable verification measures; and

(3) these verification measures would include, at a minimum, provisions for on-site inspection, cooperative measures for the exchange of seismic data, and the establishment of a monitoring committee of experts.

### SEC. 6. ANNUAL REPORT.

Three months after a cessation of the testing of nuclear warheads takes effect under this Act and annually thereafter while such cessation remains in effect, the President shall report to Congress—

(1) on the progress being made by the United States in negotiating nuclear arms control agreements with the Soviet Union; and

(2) on whether the President believes that continuation of the cessation of nuclear testing is in the national security interest of the United States.

### SEC. 7. DEFINITION.

For purposes of this Act, the term "testing of nuclear warheads" means the detonation of a nuclear explosive device.

# APPENDIX D

## 1985 NPT REVIEW CONFERENCE

## FINAL DECLARATION

THE STATES PARTY TO THE TREATY ON THE NON-PROLIFERATION OF NUCLEAR WEAPONS WHICH MET IN GENEVA FROM 27 AUGUST TO 21 SEPTEMBER 1985 TO REVIEW THE OPERATION OF THE TREATY SOLEMNLY DECLARE:

- THEIR CONVICTION THAT THE TREATY IS ESSENTIAL TO INTERNATIONAL PEACE AND SECURITY,

- THEIR CONTINUED SUPPORT FOR THE OBJECTIVES OF THE TREATY WHICH ARE:

    - THE PREVENTION OF PROLIFERATION OF NUCLEAR WEAPONS OR OTHER NUCLEAR EXPLOSIVE DEVICES;

    - THE CESSATION OF THE NUCLEAR ARMS RACE, NUCLEAR DISARMAMENT AND A TREATY ON GENERAL AND COMPLETE DISARMAMENT;

    - THE PROMOTION OF CO-OPERATION BETWEEN STATES PARTIES IN THE FIELD OF THE PEACEFUL USES OF NUCLEAR ENERGY,

- THE REAFFIRMATION OF THEIR FIRM COMMITMENT TO THE PURPOSES OF THE PREAMBLE AND THE PROVISIONS OF THE TREATY,

- THEIR DETERMINATION TO ENHANCE THE IMPLEMENTATION OF THE TREATY AND TO FURTHER STRENGTHEN ITS AUTHORITY.

### REVIEW OF THE OPERATION OF THE TREATY AND RECOMMENDATIONS

### ARTICLES I AND II AND PREAMBULAR PARAGRAPHS 1-3

1. THE CONFERENCE NOTED THE CONCERNS AND CONVICTIONS EXPRESSED IN PREAMBULAR PARAGRAPHS 1 TO 3 AND AGREED THAT THEY REMAIN VALID. THE STATES PARTY TO THE TREATY REMAIN RESOLVED IN THEIR BELIEF IN THE NEED TO AVOID THE DEVASTATION THAT A NUCLEAR WAR WOULD BRING. THE CONFERENCE REMAINS CONVINCED THAT ANY PROLIFERATION OF NUCLEAR WEAPONS WOULD SERIOUSLY INCREASE THE DANGER OF A NUCLEAR WAR.

2. THE CONFERENCE AGREED THAT THE STRICT OBSERVANCE OF THE TERMS OF ARTICLES I AND II REMAINS CENTRAL TO ACHIEVING THE SHARED OBJECTIVES OF PREVENTING UNDER ANY CIRCUMSTANCES THE FURTHER PROLIFERATION OF NUCLEAR WEAPONS AND PRESERVING THE TREATY'S VITAL CONTRIBUTION TO PEACE AND SECURITY, INCLUDING TO THE PEACE AND SECURITY OF NON-PARTIES.

3. THE CONFERENCE ACKNOWLEDGED THE DECLARATIONS BY NUCLEAR-WEAPONS STATES PARTY TO THE TREATY THAT THEY HAD FULFILLED THEIR OBLIGATIONS UNDER ARTICLE I. THE CONFERENCE FURTHER

ACKNOWLEDGED THE DECLARATIONS THAT NON-NUCLEAR-WEAPONS STATES PARTY TO THE TREATY HAD FULFILLED THEIR OBLIGATIONS UNDER ARTICLE II. THE CONFERENCE WAS OF THE VIEW THEREFORE THAT ONE OF THE PRIMARY OBJECTIVES OF THE TREATY HAD BEEN ACHIEVED IN THE PERIOD UNDER REVIEW.

4. THE CONFERENCE ALSO EXPRESSED DEEP CONCERN THAT THE NATIONAL NUCLEAR PROGRAMMES OF SOME STATES NON-PARTY TO THE TREATY MAY LEAD THEM TO OBTAIN A NUCLEAR WEAPON CAPABILITY. STATES PARTY TO THE TREATY STATED THAT ANY FURTHER DETONATION OF A NUCLEAR EXPLOSIVE DEVICE BY ANY NON-NUCLEAR-WEAPON STATE WOULD CONSTITUTE A MOST SERIOUS BREACH OF THE NON-PROLIFERATION OBJECTIVE.

5. THE CONFERENCE NOTED THE GREAT AND SERIOUS CONCERNS EXPRESSED ABOUT THE NUCLEAR CAPABILITY OF SOUTH AFRICA AND ISRAEL. THE CONFERENCE FURTHER NOTED THE CALLS ON ALL STATES FOR THE TOTAL AND COMPLETE PROHIBITION OF THE TRANSFER OF ALL NUCLEAR FACILITIES, RESOURCES OR DEVICES TO SOUTH AFRICA AND ISRAEL AND TO STOP ALL EXPLOITATION OF NAMIBIAN URANIUM, NATURAL OR ENRICHED, UNTIL THE ATTAINMENT OF NAMIBIAN INDEPENDENCE.

ARTICLE III AND PREAMBULAR PARAGRAPHS 4 AND 5

1. THE CONFERENCE AFFIRMS ITS DETERMINATION TO STRENGTHEN FURTHER THE BARRIERS AGAINST THE PROLIFERATION OF NUCLEAR WEAPONS AND OTHER NUCLEAR EXPLOSIVE DEVICES TO ADDITIONAL STATES. THE SPREAD OF NUCLEAR EXPLOSIVE CAPABILITIES WOULD ADD IMMEASURABLY TO REGIONAL AND INTERNATIONAL TENSIONS AND SUSPICIONS. IT WOULD INCREASE THE RISKS OF NUCLEAR WAR AND LESSEN THE SECURITY OF ALL STATES. THE PARTIES REMAIN CONVINCED THAT UNIVERSAL ADHERENCE TO THE NON-PROLIFERATION TREATY IS THE BEST WAY TO STRENGTHEN THE BARRIERS AGAINST PROLIFERATION AND THEY URGE ALL STATES NOT PARTY TO THE TREATY TO ACCEDE TO IT. THE TREATY AND THE REGIME OF NON-PROLIFERATION IT SUPPORTS PLAY A CENTRAL ROLE IN PROMOTING REGIONAL AND INTERNATIONAL PEACE AND SECURITY, INTER ALIA, BY HELPING TO PREVENT THE SPREAD OF NUCLEAR EXPLOSIVES. THE NON-PROLIFERATION AND SAFEGUARDS COMMITMENTS IN THE TREATY ARE ESSENTIAL ALSO FOR PEACEFUL NUCLEAR COMMERCE AND CO-OPERATION.

2. THE CONFERENCE EXPRESSES THE CONVICTION THAT IAEA SAFEGUARDS PROVIDE ASSURANCE THAT STATES ARE COMPLYING WITH THEIR UNDERTAKINGS AND ASSIST STATES IN DEMONSTRATING THIS COMPLIANCE THEY THEREBY PROMOTE FURTHER CONFIDENCE AMONG STATES AND, BEING A FUNDAMENTAL ELEMENT OF THE TREATY, HELP TO STRENGTHEN THEIR COLLECTIVE SECURITY. IAEA SAFEGUARDS PLAY A KEY ROLE IN PREVENTING THE PROLIFERATION OF NUCLEAR WEAPONS AND OTHER NUCLEAR EXPLOSIVE DEVICES. UNSAFEGUARDED NUCLEAR ACTIVITIES IN NON-NUCLEAR-WEAPON STATES POSE SERIOUS PROLIFERATION DANGERS

3. THE CONFERENCE DECLARES THAT THE COMMITMENT TO NON-PROLIFERATION BY NUCLEAR-WEAPON STATES PARTY TO THE TREATY PURSUANT TO ARTICLE I, BY NON-NUCLEAR-WEAPON STATES PARTY TO THE TREATY PURSUANT TO ARTICLE II, AND BY THE ACCEPTANCE OF IAEA SAFEGUARDS ON ALL PEACEFUL NUCLEAR ACTIVITIES WITHIN NON-NUCLEAR-WEAPON STATES PARTY TO THE TREATY PURSUANT TO ARTICLE III IS A MAJOR CONTRIBUTION BY THOSE STATES TO REGIONAL AND INTERNATIONAL SECURITY. THE CONFERENCE NOTES WITH SATISFACTION THAT THE COMMITMENTS IN ARTICLES I-III HAVE BEEN MET AND HAVE GREATLY HELPED PREVENT THE SPREAD OF NUCLEAR EXPLOSIVES.

4. THE CONFERENCE THEREFORE SPECIFICALLY URGES ALL NON-NUCLEAR-WEAPON STATES NOT PARTY TO THE TREATY TO MAKE AN INTERNATIONAL LEGALLY-BINDING COMMITMENT NOT TO ACQUIRE NUCLEAR WEAPONS OR OTHER NUCLEAR EXPLOSIVE DEVICES AND TO ACCEPT IAEA SAFEGUARDS ON ALL THEIR PEACEFUL NUCLEAR ACTIVITIES, BOTH CURRENT AND FUTURE, TO VERIFY THAT COMMITMENT. THE CONFERENCE FURTHER URGES ALL STATES IN THEIR INTERNATIONAL NUCLEAR CO-OPERATION AND IN THEIR NUCLEAR EXPORT POLICIES AND, SPECIFICALLY AS A NECESSARY BASIS FOR THE TRANSFER OF RELEVANT NUCLEAR SUPPLIES TO NON-NUCLEAR-WEAPON STATES, TO TAKE EFFECTIVE STEPS TOWARDS ACHIEVING SUCH A COMMITMENT TO NON-PROLIFERATION AND ACCEPTANCE OF SUCH SAFEGUARDS BY THOSE STATES. THE CONFERENCE EXPRESSES ITS VIEW THAT ACCESSION TO THE NON-PROLIFERATION TREATY IS THE BEST WAY TO ACHIEVE THAT OBJECTIVE.

5. THE CONFERENCE EXPRESSES ITS SATISFACTION THAT FOUR OF THE FIVE NUCLEAR-WEAPON STATES HAVE VOLUNTARILY CONCLUDED SAFEGUARDS AGREEMENTS WITH THE IAEA, COVERING ALL OR PART OF THEIR PEACEFUL NUCLEAR ACTIVITIES. THE CONFERENCE REGARDS THOSE AGREEMENTS AS FURTHER STRENGTHENING THE NON-PROLIFERATION REGIME AND INCREASING THE AUTHORITY OF IAEA AND THE EFFECTIVENESS OF ITS SAFEGUARDS SYSTEM. THE CONFERENCE CALLS ON THE NUCLEAR-WEAPON STATES TO CONTINUE TO CO-OPERATE FULLY WITH THE IAEA IN THE IMPLEMENTATION OF THESE AGREEMENTS AND CALLS ON IAEA TO TAKE FULL ADVANTAGE OF THIS CO-OPERATION. THE CONFERENCE URGES THE PEOPLE'S REPUBLIC OF CHINA SIMILARLY TO CONCLUDE A SAFEGUARDS AGREEMENT WITH IAEA. THE CONFERENCE RECOMMENDS THE CONTINUED PURSUIT OF THE PRINCIPLE OF UNIVERSAL APPLICATION OF IAEA SAFEGUARDS TO ALL PEACEFUL NUCLEAR ACTIVITIES IN ALL STATES. TO THIS END, THE CONFERENCE RECOGNIZES THE VALUE OF VOLUNTARY OFFERS AND RECOMMENDS FURTHER EVALUATION OF THE ECONOMIC AND PRACTICAL POSSIBILITY OF EXTENDING APPLICATION OF SAFEGUARDS TO ADDITIONAL CIVIL FACILITIES IN THE NUCLEAR-WEAPON STATES AS AND WHEN IAEA RESOURCES PERMIT AND CONSIDERATION OF SEPARATION OF THE CIVIL AND MILITARY FACILITIES IN THE NUCLEAR-WEAPON STATES. SUCH AN EXTENDING OF SAFEGUARDS WILL ENABLE THE FURTHER DEVELOPMENT AND APPLICATION OF AN EFFECTIVE REGIME IN BOTH NUCLEAR-WEAPON STATES AND NON-NUCLEAR-WEAPON STATES.

6. THE CONFERENCE ALSO AFFIRMS THE GREAT VALUE TO THE NON-PROLIFERATION REGIME OF COMMITMENTS BY THE NUCLEAR-WEAPON STATES THAT NUCLEAR SUPPLIES PROVIDED FOR PEACEFUL USE WILL NOT BE USED FOR NUCLEAR WEAPONS OR OTHER NUCLEAR EXPLOSIVE PURPOSES. SAFEGUARDS IN NUCLEAR-WEAPON STATES PURSUANT TO THEIR SAFEGUARDS AGREEMENTS WITH IAEA CAN VERIFY OBSERVANCE OF THOSE COMMITMENTS.

7. THE CONFERENCE NOTES WITH SATISFACTION THE ADHERENCE OF FURTHER PARTIES TO THE TREATY AND THE CONCLUSION OF FURTHER SAFEGUARDS AGREEMENTS IN COMPLIANCE WITH THE UNDERTAKING OF THE TREATY AND RECOMMENDS THAT:

(A) THE NON-NUCLEAR-WEAPON STATES PARTY TO THE TREATY THAT HAVE NOT CONCLUDED THE AGREEMENTS REQUIRED UNDER ARTICLE III(4) CONCLUDE SUCH AGREEMENTS WITH IAEA AS SOON AS POSSIBLE;

(B) THE DIRECTOR-GENERAL OF IAEA INTENSIFY HIS INITIATIVE OF SUBMITTING TO STATES CONCERNED DRAFT AGREEMENTS TO FACILITATE THE CONCLUSION OF CORRESPONDING SAFEGUARDS AGREEMENTS, AND THAT PARTIES TO THE TREATY, IN PARTICULAR DEPOSITARY PARTIES, SHOULD ACTIVELY SUPPORT THESE INITIATIVES;

(C) ALL STATES PARTY TO THE TREATY MAKE STRENUOUS INDIVIDUAL AND COLLECTIVE EFFORTS TO MAKE THE TREATY TRULY UNIVERSAL.

8. THE CONFERENCE NOTES WITH SATISFACTION THAT IAEA IN CARRYING OUT ITS SAFEGUARDS ACTIVITIES HAS NOT DETECTED ANY DIVERSION OF A SIGNIFICANT AMOUNT OF SAFEGUARDED MATERIAL TO THE PRODUCTION OF NUCLEAR WEAPONS, OTHER NUCLEAR EXPLOSIVE DEVICES OR TO PURPOSES UNKNOWN.

9. THE CONFERENCE NOTES THAT IAEA SAFEGUARDS ACTIVITIES HAVE NOT HAMPERED THE ECONOMIC, SCIENTIFIC OR TECHNOLOGICAL DEVELOPMENT OF THE PARTIES TO THE TREATY, OR INTERNATIONAL CO-OPERATION IN PEACEFUL NUCLEAR ACTIVITIES AND IT URGES THAT THIS SITUATION BE MAINTAINED.

10. THE CONFERENCE COMMENDS IAEA ON ITS IMPLEMENTATION OF SAFEGUARDS PURSUANT TO THIS TREATY AND URGES IT TO CONTINUE TO ENSURE THE MAXIMUM TECHNICAL AND COST EFFECTIVENESS AND EFFICIENCY OF ITS OPERATIONS, WHILE MAINTAINING CONSISTENCY WITH THE ECONOMIC AND SAFE CONDUCT OF NUCLEAR ACTIVITIES.

11. THE CONFERENCE NOTES WITH SATISFACTION THE IMPROVEMENT OF IAEA SAFEGUARDS WHICH HAS ENABLED IT TO CONTINUE TO APPLY SAFEGUARDS EFFECTIVELY DURING A PERIOD OF RAPID GROWTH IN THE NUMBER OF SAFEGUARDED FACILITIES. IT ALSO NOTES THAT IAEA SAFEGUARDS APPROACHES ARE CAPABLE OF ADEQUATELY DEALING WITH FACILITIES UNDER SAFEGUARDS. IN THIS REGARD, THE RECENT CONCLUSION OF THE PROJECT TO DESIGN A SAFEGUARDS REGIME FOR CENTRIFUGE ENRICHMENT PLANTS AND ITS IMPLEMENTATION IS WELCOMED.

THIS PROJECT ALLOWS THE APPLICATION OF AN EFFECTIVE REGIME TO ALL PLANTS OF THIS TYPE IN THE TERRITORIES BOTH OF NUCLEAR-WEAPON STATES AND NON-NUCLEAR-WEAPON STATES PARTIES TO THE TREATY.

12. THE CONFERENCE EMPHASIZES THE IMPORTANCE OF CONTINUED IMPROVEMENTS IN THE EFFECTIVENESS AND EFFICIENCY OF IAEA SAFEGUARDS, FOR EXAMPLE, BUT NOT LIMITED TO:

(A) UNIFORM AND NON-DISCRIMINATORY IMPLEMENTATION OF SAFEGUARDS;

(B) THE EXPEDITIOUS IMPLEMENTATION OF NEW INSTRUMENTS AND TECHNIQUES;

(C) THE FURTHER DEVELOPMENT OF METHODS FOR EVALUATION OF SAFEGUARDS EFFECTIVENESS IN COMBINATION WITH SAFEGUARDS INFORMATION;

(D) CONTINUED INCREASES IN THE EFFICIENCY OF THE USE OF HUMAN AND FINANCIAL RESOURCES AND OF EQUIPMENT.

13. THE CONFERENCE BELIEVES THAT FURTHER IMPROVEMENT OF THE LIST OF MATERIALS AND EQUIPMENT WHICH, IN ACCORDANCE WITH ARTICLE III(2) OF THE TREATY, CALLS FOR THE APPLICATION OF IAEA SAFEGUARDS SHOULD TAKE ACCOUNT OF ADVANCES IN TECHNOLOGY.

14. THE CONFERENCE RECOMMENDS THAT IAEA ESTABLISH AN INTERNATIONALLY AGREED EFFECTIVE SYSTEM OF INTERNATIONAL PLUTONIUM STORAGE IN ACCORDANCE WITH ARTICLE XII(A)5 OF ITS STATUTE.

15. THE CONFERENCE WELCOMES THE SIGNIFICANT CONTRIBUTIONS MADE BY STATES PARTIES IN FACILITATING THE APPLICATION OF IAEA SAFEGUARDS AND IN SUPPORTING RESEARCH, DEVELOPMENT AND OTHER SUPPORTS TO FURTHER THE APPLICATION OF EFFECTIVE AND EFFICIENT SAFEGUARDS. THE CONFERENCE URGES THAT SUCH CO-OPERATION AND SUPPORT BE CONTINUED AND THAT OTHER STATES PARTIES PROVIDE SIMILAR SUPPORT.

16. THE CONFERENCE CALLS UPON ALL STATES TO TAKE IAEA SAFEGUARDS REQUIREMENTS FULLY INTO ACCOUNT WHILE PLANNING, DESIGNING AND CONSTRUCTING NEW NUCLEAR FUEL CYCLE FACILITIES AND WHILE MODIFYING EXISTING NUCLEAR FUEL CYCLE FACILITIES.

17. THE CONFERENCE ALSO CALLS ON STATES PARTIES TO THE TREATY TO ASSIST IAEA IN APPLYING ITS SAFEGUARDS, INTER ALIA, THROUGH THE EFFICIENT OPERATION OF STATES SYSTEMS OF ACCOUNTING FOR AND CONTROL OF NUCLEAR MATERIAL, AND INCLUDING COMPLIANCE WITH ALL NOTIFICATION REQUIREMENTS IN ACCORDANCE WITH SAFEGUARDS AGREEMENTS.

18. THE CONFERENCE WELCOMES THE AGENCY'S ENDEAVORS TO RECRUIT AND TRAIN STAFF OF THE HIGHEST PROFESSIONAL STANDARDS FOR SAFEGUARDS IMPLEMENTATION WITH DUE REGARD TO THE WIDEST POSSIBLE GEOGRAPHICAL DISTRIBUTION, IN ACCORDANCE WITH ARTICLE VII(D) OF THE IAEA STATUTE. IT CALLS UPON STATES TO EXERCISE THEIR RIGHT REGARDING PROPOSALS OF DESIGNATION OF IAEA INSPECTORS IN SUCH A WAY AS TO FACILITATE THE MOST EFFECTIVE USE OF SAFEGUARDS MANPOWER.

19. THE CONFERENCE ALSO COMMENDS TO ALL STATES PARTIES THE MERITS OF ESTABLISHMENT OF INTERNATIONAL FUEL CYCLE FACILITIES, INCLUDING MULTINATION PARTICIPATION, AS A POSITIVE CONTRIBUTION TO REASSURANCE OF THE PEACEFUL USE AND NON-DIVERSION OF NUCLEAR MATERIALS. WHILE PRIMARILY A NATIONAL RESPONSIBILITY, THE CONFERENCE SEES ADVANTAGES IN INTERNATIONAL CO-OPERATION CONCERNING SPENT FUEL STORAGE AND NUCLEAR WASTE STORAGE.

20. THE CONFERENCE CALLS UPON STATES PARTIES TO CONTINUE THEIR POLITICAL, TECHNICAL AND FINANCIAL SUPPORT OF THE IAEA SAFEGUARDS SYSTEM.

21. THE CONFERENCE UNDERLINES THE NEED FOR IAEA TO BE PROVIDED WITH THE NECESSARY FINANCIAL AND HUMAN RESOURCES TO ENSURE THAT THE AGENCY IS ABLE TO CONTINUE TO MEET EFFECTIVELY ITS SAFEGUARDS RESPONSIBILITIES.

22. THE CONFERENCE URGES ALL STATES THAT HAVE NOT DONE SO TO ADHERE TO THE CONVENTION ON THE PHYSICAL PROTECTION OF NUCLEAR MATERIAL AT THE EARLIEST POSSIBLE DATE.

## ARTICLE IV AND PREAMBULAR PARAGRAPHS 6 AND 7

1. THE CONFERENCE AFFIRMS THAT THE NPT FOSTERS THE WORLD-WIDE PEACEFUL USE OF NUCLEAR ENERGY AND REAFFIRMS THAT NOTHING IN THE TREATY SHALL BE INTERPRETED AS AFFECTING THE INALIENABLE RIGHT OF ANY PARTY TO THE TREATY TO DEVELOP RESEARCH, PRODUCTION AND USE OF NUCLEAR ENERGY FOR PEACEFUL PURPOSES WITHOUT DISCRIMINATION AND IN CONFORMITY WITH ARTICLES I AND II.

2. THE CONFERENCE REAFFIRMS THE UNDERTAKING BY ALL PARTIES TO THE TREATY, IN ACCORDANCE WITH ARTICLE IV AND PREAMBULAR PARAGRAPHS 6 AND 7, TO FACILITATE THE FULLEST POSSIBLE EXCHANGE OF EQUIPMENT, MATERIALS AND SCIENTIFIC AND TECHNOLOGICAL INFORMATION FOR THE PEACEFUL USES OF NUCLEAR ENERGY AND THE RIGHT OF ALL PARTIES TO THE TREATY TO PARTICIPATE IN SUCH EXCHANGE. IN THIS CONTEXT, THE CONFERENCE RECOGNIZES THE IMPORTANCE OF SERVICES. THIS CAN CONTRIBUTE TO PROGRESS IN GENERAL AND TO THE ELIMINATION OF TECHNOLOGICAL AND ECONOMIC GAPS BETWEEN THE DEVELOPED AND DEVELOPING COUNTRIES.

3. THE CONFERENCE REAFFIRMS THE UNDERTAKING OF THE PARTIES TO THE TREATY IN A POSITION TO DO SO TO CO-OPERATE IN

CONTRIBUTING, ALONE OR TOGETHER WITH OTHER STATES OR INTERNATIONAL ORGANIZATIONS, TO THE FURTHER DEVELOPMENT OF THE APPLICATIONS OF NUCLEAR ENERGY FOR PEACEFUL PURPOSES, ESPECIALLY IN THE TERRITORIES OF THE NON-NUCLEAR-WEAPON STATES PARTY TO THE TREATY, WITH DUE CONSIDERATION FOR THE NEEDS OF THE DEVELOPING AREAS OF THE WORLD. IN THIS CONTEXT THE CONFERENCE RECOGNIZES THE PARTICULAR NEEDS OF THE LEAST DEVELOPED COUNTRIES.

4. THE CONFERENCE REQUESTS THAT STATES PARTIES CONSIDER POSSIBLE BILATERAL CO-OPERATION MEASURES TO FURTHER IMPROVE THE IMPLEMENTATION OF ARTICLE IV. TO THIS END, STATES PARTIES ARE REQUESTED TO GIVE IN WRITTEN FORM THEIR EXPERIENCES IN THIS AREA IN THE FORM OF NATIONAL CONTRIBUTIONS TO BE PRESENTED IN A REPORT TO THE NEXT REVIEW CONFERENCE.

5. THE CONFERENCE RECOGNIZES THE NEED FOR MORE PREDICTABLE LONG-TERM SUPPLY ASSURANCES WITH EFFECTIVE ASSURANCE OF NON-PROLIFERATION.

6. THE CONFERENCE COMMENDS THE RECENT PROGRESS WHICH THE IAEA'S COMMITMENT ON ASSURANCES OF SUPPLY (CAS) HAS MADE TOWARDS AGREEING A SET OF PRINCIPLES RELATED TO THIS MATTER, AND EXPRESSES THE HOPE THAT THE COMMITTEE WILL COMPLETE THIS WORK SOON. THE CONFERENCE FURTHER NOTES WITH SATISFACTION THE MEASURES WHICH CAS HAS RECOMMENDED TO THE IAEA BOARD OF GOVERNORS FOR ALLEVIATING TECHNICAL AND ADMINISTRATIVE PROBLEMS IN INTERNATIONAL SHIPMENTS OF NUCLEAR ITEMS, EMERGENCY AND BACK-UP MECHANISMS, AND MECHANISMS FOR THE REVISION OF INTERNATIONAL NUCLEAR CO-OPERATION AGREEMENTS AND CALLS FOR THE EARLY COMPLETION OF THE WORK OF CAS AND THE IMPLEMENTATION OF ITS RECOMMENDATIONS.

7. THE CONFERENCE REAFFIRMS THAT IN ACCORDANCE WITH INTERNATIONAL LAW AND APPLICABLE TREATY OBLIGATIONS, STATES SHOULD FULFILL THEIR OBLIGATIONS UNDER AGREEMENTS IN THE NUCLEAR FIELD, AND ANY MODIFICATION OF SUCH AGREEMENTS, IF REQUIRED, SHOULD BE MADE ONLY BY MUTUAL CONSENT OF THE PARTIES CONCERNED.

8. THE CONFERENCE CONFIRMS THAT EACH COUNTRY'S CHOICES AND DECISIONS IN THE FIELD OF PEACEFUL USES OF NUCLEAR ENERGY SHOULD BE RESPECTED WITHOUT JEOPARDIZING THEIR RESPECTIVE FUEL CYCLE POLICIES. INTERNATIONAL CO-OPERATION IN THIS AREA, INCLUDING INTERNATIONAL TRANSFER AND SUBSEQUENT OPERATIONS SHOULD BE GOVERNED BY EFFECTIVE ASSURANCES OF NON-PROLIFERATION AND PREDICTABLE LONG-TERM SUPPLY ASSURANCES. THE ISSUANCE OF RELATED LICENSES AND AUTHORIZATION INVOLVED SHOULD TAKE PLACE IN A TIMELY FASHION.

9. WHILE RECOGNIZING THAT THE OPERATION AND MANAGEMENT OF THE BACK-END OF THE FUEL CYCLE INCLUDING NUCLEAR WASTE STORAGE ARE PRIMARILY A NATIONAL RESPONSIBILITY, THE CONFERENCE

ACKNOWLEDGES THE IMPORTANCE FOR THE PEACEFUL USES OF NUCLEAR ENERGY OF INTERNATIONAL AND MULTILATERAL COLLABORATION FOR ARRANGEMENTS IN THIS AREA.

10. THE CONFERENCE EXPRESSES ITS PROFOUND CONCERN ABOUT THE ISRAELI ATTACK ON IRAQ'S SAFEGUARDED NUCLEAR REACTOR ON 7 JUNE 1981. THE CONFERENCE RECALLS SECURITY COUNCIL RESOLUTION 487 OF 1981, STRONGLY CONDEMNING THE MILITARY ATTACK BY ISRAEL WHICH WAS UNANIMOUSLY ADOPTED BY THE COUNCIL AND WHICH CONSIDERED THAT THE SAID ATTACK CONSTITUTED A SERIOUS THREAT TO THE ENTIRE IAEA SAFEGUARDS REGIME WHICH IS THE FOUNDATION OF THE NON-PROLIFERATION TREATY. THE CONFERENCE ALSO TAKES NOTE OF THE DECISIONS AND RESOLUTIONS ADOPTED BY THE UNITED NATIONS GENERAL ASSEMBLY AND THE INTERNATIONAL ATOMIC ENERGY AGENCY ON THIS ATTACK, INCLUDING RESOLUTION 425 OF 1984 ADOPTED BY THE GENERAL CONFERENCE OF THE IAEA.

11. THE CONFERENCE RECOGNIZES THAT AN ARMED ATTACK ON A SAFEGUARDED NUCLEAR FACILITY, OR THREAT OF ATTACK, WOULD CREATE A SITUATION IN WHICH THE SECURITY COUNCIL WOULD HAVE TO ACT IMMEDIATELY IN ACCORDANCE WITH PROVISIONS OF THE UNITED NATIONS CHARTER. THE CONFERENCE FURTHER EMPHASIZES THE RESPONSIBILITIES OF THE DEPOSITARIES OF NPT IN THEIR CAPACITY AS PERMANENT MEMBERS OF THE SECURITY COUNCIL TO ENDEAVOR, IN CONSULTATION WITH THE OTHER MEMBERS OF THE SECURITY COUNCIL, TO GIVE FULL CONSIDERATION TO ALL APPROPRIATE MEASURES TO BE UNDERTAKEN BY THE SECURITY COUNCIL TO DEAL WITH THE SITUATION, INCLUDING MEASURES UNDER CHAPTER VII OF THE UNITED NATIONS CHARTER.

12. THE CONFERENCE ENCOURAGES PARTIES TO BE READY TO PROVIDE IMMEDIATE PEACEFUL ASSISTANCE IN ACCORDANCE WITH INTERNATIONAL LAW TO ANY PARTY TO THE NPT, IF IT SO REQUESTS, WHOSE SAFEGUARDED NUCLEAR FACILITIES HAVE BEEN SUBJECT TO AN ARMED ATTACK, AND CALLS UPON ALL STATES TO ABIDE BY ANY DECISIONS TAKEN BY THE SECURITY COUNCIL IN ACCORDANCE WITH THE UNITED NATIONS CHARTER IN RELATION TO THE ATTACKING STATE.

13. THE CONFERENCE CONSIDERS THAT SUCH ATTACKS COULD INVOLVE GRAVE DANGERS DUE TO THE RELEASE OF RADIOACTIVITY AND THAT SUCH ATTACKS OR THREATS OF ATTACK JEOPARDIZE THE DEVELOPMENT OF THE PEACEFUL USES OF NUCLEAR ENERGY. THE CONFERENCE ALSO ACKNOWLEDGES THAT THE MATTER IS UNDER CONSIDERATION BY THE CONFERENCE ON DISARMAMENT AND URGES CO-OPERATION OF ALL STATES FOR ITS SPEEDY CONCLUSION.

14. THE CONFERENCE ACKNOWLEDGES THE IMPORTANCE OF THE WORK OF THE INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA) AS THE PRINCIPAL AGENT FOR TECHNOLOGY TRANSFER AMONGST THE INTERNATIONAL ORGANIZATIONS REFERRED TO IN ARTICLE IV(2) AND WELCOMES THE SUCCESSFUL OPERATION OF THE AGENCY'S TECHNICAL ASSISTANCE AND CO-OPERATION PROGRAMMES. THE CONFERENCE RECORDS WITH

APPRECIATION THAT PROJECTS SUPPORTED FROM THESE PROGRAMMES COVERED A WIDE SPECTRUM OF APPLICATIONS, RELATED BOTH TO POWER AND NON-POWER USES OF NUCLEAR ENERGY NOTABLY IN AGRICULTURE, MEDICINE, INDUSTRY AND HYDROLOGY. THE CONFERENCE NOTES THAT THE AGENCY'S ASSISTANCE TO THE DEVELOPING STATES PARTY TO THE TREATY HAS BEEN CHIEFLY IN THE NON-POWER USES OF NUCLEAR ENERGY.

15. THE CONFERENCE WELCOMES THE ESTABLISHMENT BY THE IAEA, FOLLOWING A RECOMMENDATION OF THE FIRST REVIEW CONFERENCE OF THE PARTIES TO THE TREATY, OF A MECHANISM TO PERMIT THE CHANNELLING OF EXTRA-BUDGETARY FUNDS TO PROJECTS ADDITIONAL TO THOSE FINANCED FROM THE IAEA TECHNICAL ASSISTANCE AND CO-OPERATION FUND. THE CONFERENCE NOTES THAT THIS CHANNEL HAS BEEN USED TO MAKE ADDITIONAL RESOURCES AVAILABLE FOR A WIDE VARIETY OF PROJECTS IN DEVELOPING STATES PARTY TO THE TREATY.

16. IN THIS CONTEXT, THE CONFERENCE PROPOSES THE FOLLOWING MEASURES FOR CONSIDERATION BY THE IAEA:

(I) IAEA ASSISTANCE TO DEVELOPING COUNTRIES IN SITING, CONSTRUCTION, OPERATION AND SAFETY OF NUCLEAR POWER PROJECTS AND THE ASSOCIATED TRAINED MANPOWER PROVISION TO BE STRENGTHENED.

(II) TO PROVIDE, UPON REQUEST, ASSISTANCE IN SECURING FINANCING FROM OUTSIDE SOURCES FOR NUCLEAR POWER PROJECTS IN DEVELOPING COUNTRIES, AND IN PARTICULAR THE LEAST DEVELOPED COUNTRIES.

(III) IAEA ASSISTANCE IN NUCLEAR PLANNING SYSTEMS FOR DEVELOPING COUNTRIES TO BE STRENGTHENED IN ORDER TO HELP SUCH COUNTRIES DRAW UP THEIR OWN NUCLEAR DEVELOPMENT PLANS.

(IV) IAEA ASSISTANCE ON COUNTRY-SPECIFIC NUCLEAR DEVELOPMENT STRATEGIES TO BE FURTHER DEVELOPED, WITH A VIEW TO IDENTIFYING THE APPLICATION OF NUCLEAR TECHNOLOGY THAT CAN BE EXPECTED TO CONTRIBUTE MOST TO THE DEVELOPMENT BOTH OF INDIVIDUAL SECTORS AND DEVELOPING ECONOMIES AS WELL.

(V) GREATER SUPPORT FOR REGIONAL COOPERATIVE AGREEMENTS, PROMOTING REGIONAL PROJECTS BASED ON REGIONALLY AGREED PRIORITIES AND USING INPUTS FROM REGIONAL COUNTRIES.

(VI) EXPLORATION OF THE SCOPE FOR MULTI-YEAR, MULTI-DONOR PROJECTS FINANCED FROM THE EXTRA-BUDGETARY RESOURCES OF THE IAEA.

(VII) THE IAEA'S TECHNICAL CO-OPERATION EVALUATION ACTIVITY TO BE FURTHER DEVELOPED, SO AS TO ENHANCE THE AGENCY'S EFFECTIVENESS IN PROVIDING TECHNICAL ASSISTANCE.

17. THE CONFERENCE UNDERLINES THE NEED FOR THE PROVISION TO THE IAEA OF THE NECESSARY FINANCIAL AND HUMAN RESOURCES TO ENSURE THAT THE AGENCY IS ABLE TO CONTINUE TO MEET EFFECTIVELY ITS RESPONSIBILITIES.

18. THE CONFERENCE NOTES THE APPRECIABLE LEVEL OF BILATERAL CO-OPERATION IN THE PEACEFUL USES OF NUCLEAR ENERGY, AND URGES THAT STATES IN A POSITION TO DO SO SHOULD CONTINUE AND WHERE POSSIBLE INCREASE THE LEVEL OF THEIR CO-OPERATION IN THESE FIELDS.

19. THE CONFERENCE URGES THAT PREFERENTIAL TREATMENT SHOULD BE GIVEN TO THE NON-NUCLEAR-WEAPON STATES PARTY TO THE TREATY IN ACCESS TO OR TRANSFER OF EQUIPMENT, MATERIALS, SERVICES AND SCIENTIFIC AND TECHNOLOGICAL INFORMATION FOR THE PEACEFUL USES OF NUCLEAR ENERGY, TAKING PARTICULARLY INTO ACCOUNT NEEDS OF DEVELOPING COUNTRIES.

20. GREAT AND SERIOUS CONCERNS WERE EXPRESSED AT THE CONFERENCE ABOUT THE NUCLEAR CAPABILITY OF SOUTH AFRICA AND ISRAEL AND THAT THE DEVELOPMENT OF SUCH A CAPABILITY BY SOUTH AFRICA AND ISRAEL WOULD UNDERMINE THE CREDIBILITY AND STABILITY OF THE NON-PROLIFERATION TREATY REGIME. THE CONFERENCE NOTED THE DEMANDS MADE ON ALL STATES TO SUSPEND ANY CO-OPERATION WHICH WOULD CONTRIBUTE TO THE NUCLEAR PROGRAMME OF SOUTH AFRICA AND ISRAEL. THE CONFERENCE FURTHER NOTED THE DEMANDS MADE ON SOUTH AFRICA AND ISRAEL TO ACCEDE TO THE NPT, TO ACCEPT IAEA SAFEGUARDS ON ALL THEIR NUCLEAR FACILITIES AND TO PLEDGE THEMSELVES NOT TO MANUFACTURE OR AQUIRE NUCLEAR WEAPONS OR OTHER NUCLEAR EXPLOSIVE DEVICES.

21. THE CONFERENCE RECOGNIZES THE GROWING NUCLEAR ENERGY NEEDS OF THE DEVELOPING COUNTRIES AS WELL AS THE DIFFICULTIES WHICH THE DEVELOPING COUNTRIES FACE IN THIS REGARD, PARTICULARLY WITH RESPECT TO FINANCING THEIR NUCLEAR POWER PROGRAMMES. THE CONFERENCE CALLS UPON STATES PARTY TO THE TREATY TO PROMOTE THE ESTABLISHMENT OF FAVOURABLE CONDITIONS IN NATIONAL, REGIONAL AND INTERNATIONAL FINANCIAL INSTITUTIONS FOR FINANCING OF NUCLEAR ENERGY PROJECTS INCLUDING NUCLEAR POWER PROGRAMMES IN DEVELOPING COUNTRIES. FURTHERMORE, THE CONFERENCE CALLS UPON THE IAEA TO INITIATE AND THE PARTIES TO THE TREATY TO SUPPORT THE WORK OF AN EXPERT GROUP STUDY ON MECHANISMS TO ASSIST DEVELOPING COUNTRIES IN THE PROMOTION OF THEIR NUCLEAR POWER PROGRAMMES, INCLUDING THE ESTABLISHMENT OF A FINANCIAL ASSISTANCE FUND.

22. THE CONFERENCE RECOGNIZES THAT FURTHER IAEA ASSISTANCE IN THE PREPARATION OF FEASIBILITY STUDIES AND INFRASTRUCTURE DEVELOPMENT MIGHT ENHANCE THE PROSPECTS FOR DEVELOPING COUNTRIES FOR OBTAINING FINANCE, AND RECOMMENDS SUCH COUNTRIES AS ARE MEMBERS OF THE AGENCY TO APPLY FOR SUCH HELP UNDER THE AGENCY'S TECHNICAL ASSISTANCE AND CO-OPERATION PROGRAMMES.

THE CONFERENCE ALSO ACKNOWLEDGES THAT FURTHER SUPPORT FOR THE IAEA'S SMALL AND MEDIUM POWER REACTOR (SMPR) STUDY COULD HELP THE DEVELOPMENT OF NUCLEAR REACTORS MORE SUITED TO THE NEEDS OF SOME OF THE DEVELOPING COUNTRIES.

23. THE CONFERENCE EXPRESSES ITS SATISFACTION AT THE PROGRESS IN THE PREPARATIONS FOR THE UNITED NATIONS CONFERENCE FOR THE PROMOTION OF INTERNATIONAL CO-OPERATION IN THE PEACEFUL USES OF NUCLEAR ENERGY (UNCPICPUNE) AND ITS CONVICTION THAT UNCPICPUNE WILL FULLY REALIZE ITS GOALS IN ACCORDANCE WITH THE OBJECTIVES OF RESOLUTION 32/50 AND RELEVANT SUBSEQUENT RESOLUTIONS OF THE GENERAL ASSEMBLY FOR THE DEVELOPMENT OF NATIONAL PROGRAMMES OF PEACEFUL USES OF NUCLEAR ENERGY FOR ECONOMIC AND SOCIAL DEVELOPMENT, ESPECIALLY IN THE DEVELOPING COUNTRIES.

24. THE CONFERENCE CONSIDERS THAT ALL PROPOSALS RELATED TO THE PROMOTION AND STRENGTHENING OF INTERNATIONAL CO-OPERATION IN THE PEACEFUL USES OF NUCLEAR ENERGY WHICH HAVE BEEN PRODUCED BY THE THIRD REVIEW CONFERENCE OF THE NPT, BE TRANSMITTED TO THE PREPARATORY COMMITTEE OF THE UNCPICPUNE.

ARTICLE V

1. THE CONFERENCE REAFFIRMS THE OBLIGATION OF PARTIES TO THE TREATY TO TAKE APPROPRIATE MEASURES TO ENSURE THAT POTENTIAL BENEFITS FROM ANY PEACEFUL APPLICATIONS OF NUCLEAR EXPLOSIONS ARE MADE AVAILABLE TO NON-NUCLEAR-WEAPON STATES PARTY TO THE TREATY IN FULL ACCORDANCE WITH THE PROVISIONS OF ARTICLE V AND OTHER APPLICABLE INTERNATIONAL OBLIGATIONS, THAT SUCH SERVICES SHOULD BE PROVIDED TO NON-NUCLEAR-WEAPON STATES PARTY TO THE TREATY ON A NON-DISCRIMINATORY BASIS AND THAT THE CHARGE TO SUCH PARTIES FOR THE EXPLOSIVE DEVICES USED SHOULD BE AS LOW AS POSSIBLE AND EXCLUDE ANY CHARGE FOR RESEARCH AND DEVELOPMENT.

2. THE CONFERENCE CONFIRMS THAT THE IAEA WOULD BE THE APPROPRIATE INTERNATIONAL BODY THROUGH WHICH ANY POTENTIAL BENEFITS OF THE PEACEFUL APPLICATIONS OF NUCLEAR EXPLOSIONS COULD BE MADE AVAILABLE TO NON-NUCLEAR-WEAPON STATES UNDER THE TERMS OF ARTICLE V OF THE TREATY.

3. THE CONFERENCE NOTES THAT THE POTENTIAL BENEFITS OF THE PEACEFUL APPLICATIONS OF NUCLEAR EXPLOSIONS HAVE NOT BEEN DEMONSTRATED AND THAT NO REQUESTS FOR SERVICES RELATED TO THE PEACEFUL APPLICATIONS OF NUCLEAR EXPLOSIONS HAVE BEEN RECEIVED BY THE IAEA SINCE THE SECOND NPT REVIEW CONFERENCE.

## ARTICLE VI AND PREAMBULAR PARAGRAPHS 8-12

### A.

1. THE CONFERENCE RECALLED THAT UNDER THE PROVISIONS OF ARTICLE VI ALL PARTIES HAVE UNDERTAKEN TO PURSUE NEGOTIATIONS IN GOOD FAITH:

- ON EFFECTIVE MEASURES RELATING TO CESSATION OF THE NUCLEAR ARMS RACE AT AN EARLY DATE;

- ON EFFECTIVE MEASURES RELATING TO NUCLEAR DISARMAMENT;

- ON A TREATY ON GENERAL AND COMPLETE DISARMAMENT UNDER STRICT AND EFFECTIVE INTERNATIONAL CONTROL.

2. THE CONFERENCE UNDERTOOK AN EVALUATION OF THE ACHIEVEMENTS IN RESPECT TO EACH ASPECT OF THE ARTICLE IN THE PERIOD UNDER REVIEW, AND PARAGRAPHS 8 TO 12 OF THE PREAMBLE, AND IN PARTICULAR WITH REGARD TO THE GOALS SET OUT IN PREAMBULAR PARAGRAPH 10 WHICH RECALLS THE DETERMINATION EXPRESSED BY THE PARTIES TO THE PARTIAL TEST BAN TREATY TO:

- CONTINUE NEGOTIATIONS TO ACHIEVE THE DISCONTINUANCE OF ALL TEST EXPLOSIONS OF NUCLEAR WEAPONS FOR ALL TIME.

3. THE CONFERENCE RECALLED THE DECLARED INTENTION OF THE PARTIES TO THE TREATY TO ACHIEVE AT THE EARLIEST POSSIBLE DATE THE CESSATION OF THE NUCLEAR ARMS RACE AND TO UNDERTAKE EFFECTIVE MEASURES IN THE DIRECTION OF NUCLEAR DISARMAMENT AND THEIR URGING MADE TO ALL STATES PARTIES TO CO-OPERATE IN THE ATTAINMENT OF THIS OBJECTIVE. THE CONFERENCE ALSO RECALLED THE DETERMINATION EXPRESSED BY THE PARTIES TO THE 1963 TREATY BANNING NUCLEAR WEAPONS TESTS IN THE ATMOSPHERE, IN OUTER SPACE AND UNDER WATER IN ITS PREAMBLE TO SEEK TO ACHIEVE THE DISCONTINUANCE OF ALL TEST EXPLOSIONS ON NUCLEAR WEAPONS FOR ALL TIME AND THE DESIRE TO FURTHER THE EASING OF INTERNATIONAL TENSION AND THE STRENGTHENING OF TRUST BETWEEN STATES IN ORDER TO FACILITATE THE CESSATION OF THE MANUFACTURE OF NUCLEAR WEAPONS, THE LIQUIDATION OF ALL EXISTING STOCKPILES, AND THE ELIMINATION FROM NATIONAL ARSENALS OF NUCLEAR WEAPONS AND THE MEANS OF THEIR DELIVERY.

4. THE CONFERENCE NOTES THAT THE TENTH SPECIAL SESSION OF THE GENERAL ASSEMBLY OF THE UNITED NATIONS CONCLUDED, IN PARAGRAPH 50 OF ITS FINAL DOCUMENT, THAT THE ACHIEVEMENT OF NUCLEAR DISARMAMENT WILL REQUIRE URGENT NEGOTIATIONS OF AGREEMENTS AT APPROPRIATE STAGES AND WITH ADEQUATE MEASURES OF VERIFICATION SATISFACTORY TO THE STATES CONCERNED FOR:

(A) CESSATION OF THE QUALITATIVE IMPROVEMENT AND DEVELOPMENT OF NUCLEAR-WEAPON SYSTEMS;

(B) CESSATION OF THE PRODUCTION OF ALL TYPES OF NUCLEAR WEAPONS AND THEIR MEANS OF DELIVERY, AND OF THE PRODUCTION OF FISSIONABLE MATERIAL FOR WEAPONS PURPOSES;

(C) A COMPREHENSIVE, PHASED PROGRAMME WITH AGREED TIME-TABLES WHENEVER FEASIBLE, FOR PROGRESSIVE AND BALANCED REDUCTION OF STOCKPILES OF NUCLEAR WEAPONS AND THEIR MEANS OF DELIVERY, LEADING TO THEIR ULTIMATE AND COMPLETE ELIMINATION AT THE EARLIEST POSSIBLE TIME.

5. THE CONFERENCE ALSO RECALLED THAT IN THE FINAL DECLARATION OF THE FIRST REVIEW CONFERENCE, THE PARTIES EXPRESSED THE VIEW THAT THE CONCLUSION OF A TREATY BANNING ALL NUCLEAR-WEAPON TESTS WAS ONE OF THE MOST IMPORTANT MEASURES TO HALT THE NUCLEAR ARMS RACE AND EXPRESSED THE HOPE THAT THE NUCLEAR-WEAPON STATES PARTY TO THE TREATY WOULD TAKE THE LEAD IN REACHING AN EARLY SOLUTION OF THE TECHNICAL AND POLITICAL DIFFICULTIES OF THIS ISSUE.

6. THE CONFERENCE EXAMINED DEVELOPMENTS RELATING TO THE CESSATION OF THE NUCLEAR ARMS RACE, IN THE PERIOD UNDER REVIEW AND NOTED IN PARTICULAR THAT THE DESTRUCTIVE POTENTIALS OF THE NUCLEAR ARSENALS OF NUCLEAR-WEAPON STATES PARTIES, WERE UNDERGOING CONTINUING DEVELOPMENT, INCLUDING A GROWING RESEARCH AND DEVELOPMENT COMPONENT IN MILITARY SPENDING, CONTINUED NUCLEAR TESTING, DEVELOPMENT OF NEW DELIVERY SYSTEMS AND THEIR DEPLOYMENT.

7. THE CONFERENCE NOTED THE CONCERNS EXPRESSED REGARDING DEVELOPMENTS WITH FAR REACHING IMPLICATIONS AND THE POTENTIAL OF A NEW ENVIRONMENT, SPACE, BEING DRAWN INTO THE ARMS RACE. IN THAT REGARD THE CONFERENCE ALSO NOTED THE FACT THAT THE UNITED STATES OF AMERICA AND THE UNION OF SOVIET SOCIALIST REPUBLICS ARE PURSUING BILATERAL NEGOTIATIONS ON A BROAD COMPLEX OF QUESTIONS CONCERNING SPACE AND NUCLEAR ARMS, WITH A VIEW TO ACHIEVING EFFECTIVE AGREEMENTS AIMED AT PREVENTING AN ARMS RACE IN SPACE AND TERMINATING IT ON EARTH.

8. THE CONFERENCE NOTED WITH REGRET THAT THE DEVELOPMENT AND DEPLOYMENT OF NUCLEAR WEAPON SYSTEMS HAD CONTINUED DURING THE PERIOD OF REVIEW.

9. THE CONFERENCE ALSO TOOK NOTE OF NUMEROUS PROPOSALS AND ACTIONS, MULTILATERAL AND UNILATERAL, ADVANCED DURING THE PERIOD UNDER REVIEW BY MANY STATES WITH THE AIM OF MAKING PROGRESS TOWARDS THE CESSATION OF THE NUCLEAR ARMS RACE AND NUCLEAR DISARMAMENT.

10. THE CONFERENCE EXAMINED THE EXISTING SITUATION IN THE LIGHT OF THE UNDERTAKING ASSUMED BY THE PARTIES IN ARTICLE VI TO PURSUE NEGOTIATIONS IN GOOD FAITH ON EFFECTIVE MEASURES RELATING TO CESSATION OF THE NUCLEAR ARMS RACE AT AN EARLY

DATE AND TO NUCLEAR DISARMAMENT. THE CONFERENCE RECALLED THAT A STAGE OF NEGOTIATIONS ON THE STRATEGIC ARMS LIMITATION TALKS (SALT II) HAD BEEN CONCLUDED IN 1979, BY THE SIGNING OF THE TREATY WHICH HAD REMAINED UNRATIFIED. THE CONFERENCE NOTED THAT BOTH THE UNION OF SOVIET SOCIALIST REPUBLICS AND THE UNITED STATES OF AMERICA HAD DECLARED THAT THEY ARE ABIDING BY THE PROVISIONS OF SALT II.

11. THE CONFERENCE RECALLED THAT THE BILATERAL NEGOTIATIONS BETWEEN THE UNION OF SOVIET SOCIALIST REPUBLICS AND THE UNITED STATES OF AMERICA WHICH WERE HELD BETWEEN 1981 AND 1983 WERE DISCONTINUED WITHOUT ANY CONCRETE RESULTS.

12. THE CONFERENCE NOTED THAT BILATERAL NEGOTIATIONS BETWEEN THE UNION OF SOVIET SOCIALIST REPUBLICS AND THE UNITED STATES OF AMERICA HAD BEEN HELD IN 1985 TO CONSIDER QUESTIONS CONCERNING SPACE AND NUCLEAR ARMS, BOTH STRATEGIC AND INTERMEDIATE-RANGE, WITH ALL THE QUESTIONS CONSIDERED AND RESOLVED IN THEIR INTERRELATIONSHIP. NO AGREEMENT HAS EMERGED SO FAR. THESE NEGOTIATIONS ARE CONTINUING.

13. THE CONFERENCE EVALUATED THE PROGRESS MADE IN MULTILATERAL NUCLEAR DISARMAMENT NEGOTIATIONS IN THE PERIOD OF THE REVIEW.

14. THE CONFERENCE RECALLED THAT THE TRILATERAL NEGOTIATIONS ON A COMPREHENSIVE TEST BAN TREATY, BEGUN IN 1977 BETWEEN THE UNION OF SOVIET SOCIALIST REPUBLICS, THE UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND AND THE UNITED STATES OF AMERICA, HAD NOT CONTINUED AFTER 1980, THAT THE COMMITTEE ON DISARMAMENT AND LATER THE CONFERENCE ON DISARMAMENT HAD BEEN CALLED UPON BY THE GENERAL ASSEMBLY OF THE UNITED NATIONS IN SUCCESSIVE YEARS TO BEGIN NEGOTIATIONS ON SUCH A TREATY, AND NOTED THAT SUCH NEGOTIATIONS HAD NOT BEEN INITIATED, DESPITE THE SUBMISSION OF DRAFT TREATIES AND DIFFERENT PROPOSALS TO THE CONFERENCE ON DISARMAMENT IN THIS REGARD.

15. THE CONFERENCE NOTED THE LACK OF PROGRESS ON RELEVANT ITEMS OF THE AGENDA OF THE CONFERENCE ON DISARMAMENT, IN PARTICULAR THOSE RELATING TO THE CESSATION OF THE NUCLEAR ARMS RACE AND NUCLEAR DISARMAMENT, THE PREVENTION OF NUCLEAR WAR INCLUDING ALL RELATED MATTERS AND EFFECTIVE INTERNATIONAL ARRANGEMENTS TO ASSURE NON-NUCLEAR-WEAPON STATES AGAINST THE USE OR THREAT OF USE OF NUCLEAR WEAPONS.

16. THE CONFERENCE NOTED THAT TWO REVIEW CONFERENCES HAD TAKEN PLACE SINCE 1980, ONE OF THE SEA-BED TREATY AND ONE ON THE ENVIRONMENTAL MODIFICATION TREATY AND THREE GENERAL CONFERENCES OF THE AGENCY FOR THE PROHIBITION OF NUCLEAR WEAPONS IN LATIN AMERICA. IN 1982, A SPECIAL UNITED NATIONS GENERAL ASSEMBLY SESSION ON DISARMAMENT TOOK PLACE WITHOUT ANY RESULTS IN MATTERS DIRECTLY LINKED TO NUCLEAR DISARMAMENT.

17. THE CONFERENCE ALSO NOTED THE LAST FIVE YEARS HAD THUS NOT GIVEN ANY RESULTS CONCERNING NEGOTIATIONS ON EFFECTIVE MEASURES RELATING TO CESSATION OF THE NUCLEAR ARMS RACE AND TO NUCLEAR DISARMAMENT.

B.

1. THE CONFERENCE CONCLUDED THAT, SINCE NO AGREEMENTS HAD BEEN REACHED IN THE PERIOD UNDER REVIEW ON EFFECTIVE MEASURES RELATING TO THE CESSATION OF AN ARMS RACE AT AN EARLY DATE, ON NUCLEAR DISARMAMENT AND ON A TREATY ON GENERAL AND COMPLETE DISARMAMENT UNDER STRICT AND EFFECTIVE INTERNATIONAL CONTROL, THE ASPIRATIONS CONTAINED IN PREAMBULAR PARAGRAPHS 8 TO 12 HAD STILL NOT BEEN MET, AND THE OBJECTIVES UNDER ARTICLE VI HAD NOT YET BEEN ACHIEVED.

2. THE CONFERENCE REITERATED THAT THE IMPLEMENTATION OF ARTICLE VI IS ESSENTIAL TO THE MAINTENANCE AND STRENGTHENING OF THE TREATY, REAFFIRMED THE COMMITMENT OF ALL STATES PARTIES TO THE IMPLEMENTATION OF THIS ARTICLE AND CALLED UPON THE STATES PARTIES TO INTENSIFY THEIR EFFORTS TO ACHIEVE FULLY THE OBJECTIVES OF THE ARTICLE. THE CONFERENCE ADDRESSED A CALL TO THE NUCLEAR-WEAPON STATES PARTIES IN PARTICULAR TO DEMONSTRATE THIS COMMITMENT.

3. THE CONFERENCE WELCOMES THE FACT THAT THE UNITED STATES OF AMERICA AND THE UNION OF SOVIET SOCIALIST REPUBLICS ARE CONDUCTING BILATERAL NEGOTIATIONS ON A COMPLEX OF QUESTIONS CONCERNING SPACE AND NUCLEAR ARMS - BOTH STRATEGIC AND INTERMEDIATE-RANGE - WITH ALL THESE QUESTIONS CONSIDERED AND RESOLVED IN THEIR INTERRELATIONSHIP. IT HOPES THAT THESE NEGOTIATIONS WILL LEAD TO EARLY AND EFFECTIVE AGREEMENTS AIMED AT PREVENTING AN ARMS RACE IN SPACE AND TERMINATING IT ON EARTH, AT LIMITING AND REDUCING NUCLEAR ARMS, AND AT STRENGTHENING STRATEGIC STABILITY. SUCH AGREEMENTS WILL COMPLEMENT AND ENSURE THE POSITIVE OUTCOME OF MULTILATERAL NEGOTIATIONS ON DISARMAMENT, AND WOULD LEAD TO THE REDUCTION OF INTERNATIONAL TENSIONS AND THE PROMOTION OF INTERNATIONAL PEACE AND SECURITY. THE CONFERENCE RECALLS THAT THE TWO SIDES BELIEVE THAT ULTIMATELY THE BILATERAL NEGOTIATIONS, JUST AS EFFORTS IN GENERAL TO LIMIT AND REDUCE ARMS, SHOULD LEAD TO THE COMPLETE ELIMINATION OF NUCLEAR ARMS EVERYWHERE.

4. THE CONFERENCE URGES THE CONFERENCE ON DISARMAMENT, AS APPROPRIATE, TO PROCEED TO EARLY MULTILATERAL NEGOTIATIONS ON NUCLEAR DISARMAMENT IN PURSUANCE OF PARAGRAPH 50 OF THE FINAL DOCUMENT OF THE FIRST SPECIAL SESSION OF THE GENERAL ASSEMBLY OF THE UNITED NATIONS DEVOTED TO DISARMAMENT.

5. THE CONFERENCE REAFFIRMS THE DETERMINATION EXPRESSED IN THE PREAMBLE OF THE 1963 PARTIAL TEST BAN TREATY, CONFIRMED IN ARTICLE I(B) OF THE SAID TREATY AND REITERATED IN PREAMBULAR

PARAGRAPH 10 OF THE NON-PROLIFERATION TREATY, TO ACHIEVE THE DISCONTINUANCE OF ALL TEST EXPLOSIONS OF NUCLEAR WEAPONS FOR ALL TIME.

6. THE CONFERENCE ALSO RECALLS THAT IN THE FINAL DOCUMENT OF THE FIRST REVIEW CONFERENCE, THE PARTIES EXPRESSED THE VIEW THAT THE CONCLUSION OF A TREATY BANNING ALL NUCLEAR WEAPONS TESTS WAS ONE OF THE MOST IMPORTANT MEASURES TO HALT THE NUCLEAR ARMS RACE. THE CONFERENCE STRESSES THE IMPORTANT CONTRIBUTION THAT SUCH A TREATY WOULD MAKE TOWARD STRENGTHENING AND EXTENDING THE INTERNATIONAL BARRIERS AGAINST THE PROLIFERATION OF NUCLEAR WEAPONS; IT FURTHER STRESSES THAT ADHERENCE TO SUCH A TREATY BY ALL STATES WOULD CONTRIBUTE SUBSTANTIALLY TO THE FULL ACHIEVEMENT OF THE NON-PROLIFERATION OBJECTIVE.

7. THE CONFERENCE ALSO TOOK NOTE OF THE APPEALS CONTAINED IN FIVE SUCCESSIVE UNITED NATIONS GENERAL ASSEMBLY RESOLUTIONS SINCE 1981 FOR A MORATORIUM ON NUCLEAR WEAPONS TESTING PENDING THE CONCLUSION OF A COMPREHENSIVE TEST BAN TREATY, AND OF SIMILAR CALLS MADE AT THIS CONFERENCE. IT ALSO TOOK NOTE OF THE MEASURE ANNOUNCED BY THE UNION OF SOVIET SOCIALIST REPUBLICS FOR A UNILATERAL MORATORIUM ON ALL NUCLEAR EXPLOSIONS FROM 6 AUGUST 1985 UNTIL 1 JANUARY 1986, WHICH WOULD CONTINUE BEYOND THAT DATE IF THE UNITED STATES OF AMERICA, FOR ITS PART, REFRAINED FROM CARRYING OUT NUCLEAR EXPLOSIONS. THE UNION OF SOVIET SOCIALIST REPUBLICS SUGGESTED THAT THIS WOULD PROVIDE AN EXAMPLE FOR OTHER NUCLEAR WEAPONS STATES AND WOULD CREATE FAVOURABLE CONDITIONS FOR THE CONCLUSION OF A COMPREHENSIVE TEST BAN TREATY AND THE PROMOTION OF THE FULLER IMPLEMENTATION OF THE NON-PROLIFERATION TREATY.

8. THE CONFERENCE TOOK NOTE OF THE UNCONDITIONAL INVITATION EXTENDED BY THE UNITED STATES OF AMERICA TO THE UNION OF SOVIET SOCIALIST REPUBLICS TO SEND OBSERVERS, WHO MAY BRING ANY EQUIPMENT THEY DEEM NECESSARY, TO MEASURE A UNITED STATES OF AMERICA NUCLEAR TEST IN ORDER TO BEGIN A PROCESS WHICH IN THE VIEW OF THE UNITED STATES OF AMERICA WOULD HELP TO ENSURE EFFECTIVE VERIFICATION OF LIMITATIONS ON UNDER-GROUND NUCLEAR TESTING.

9. THE CONFERENCE ALSO TOOK NOTE OF THE APPEALS CONTAINED IN FIVE UNITED NATIONS GENERAL ASSEMBLY RESOLUTIONS SINCE 1982 FOR A FREEZE ON ALL NUCLEAR WEAPONS IN QUANTITATIVE AND QUALITATIVE TERMS, WHICH SHOULD BE TAKEN BY ALL NUCLEAR-WEAPON STATES OR, IN THE FIRST INSTANCE AND SIMULTANEOUSLY, BY THE UNION OF SOVIET SOCIALIST REPUBLICS AND THE UNITED STATES OF AMERICA ON THE UNDERSTANDING THAT THE OTHER NUCLEAR-WEAPON STATES WOULD FOLLOW THEIR EXAMPLE, AND OF SIMILAR CALLS MADE AT THIS CONFERENCE.

10. THE CONFERENCE TOOK NOTE OF PROPOSALS BY THE UNION OF SOVIET SOCIALIST REPUBLICS AND THE UNITED STATES OF AMERICA FOR THE REDUCTION OF NUCLEAR WEAPONS.

11. THE CONFERENCE TOOK NOTE OF PROPOSALS SUBMITTED BY STATES PARTIES ON A NUMBER OF RELATED ISSUES RELEVANT TO ACHIEVING THE PURPOSES OF ARTICLE VI AND SET OUT IN ANNEX I TO THIS DOCUMENT AND IN THE STATEMENTS MADE IN THE GENERAL DEBATE OF THE CONFERENCE.

12. THE CONFERENCE REITERATED ITS CONVICTION THAT THE OBJECTIVES OF ARTICLE VI REMAINED UNFULFILLED AND CONCLUDED THAT THE NUCLEAR-WEAPON STATES SHOULD MAKE GREATER EFFORTS TO ENSURE EFFECTIVE MEASURES FOR THE CESSATION OF THE NUCLEAR ARMS RACE AT AN EARLY DATE, FOR NUCLEAR DISARMAMENT AND FOR A TREATY ON GENERAL AND COMPLETE DISARMAMENT UNDER STRICT AND EFFECTIVE INTERNATIONAL CONTROL.

13. THE CONFERENCE EXPRESSED THE HOPE FOR RAPID PROGRESS IN THE US-USSR BILATERAL NEGOTIATIONS.

14. THE CONFERENCE EXCEPT FOR CERTAIN STATES WHOSE VIEWS ARE REFLECTED IN THE FOLLOWING SUB-PARAGRAPH DEEPLY REGRETTED THAT A COMPREHENSIVE MULTILATERAL NUCLEAR TEST BAN TREATY BANNING ALL NUCLEAR TESTS BY ALL STATES IN ALL ENVIRONMENTS FOR ALL TIME HAD NOT BEEN CONCLUDED SO FAR AND, THEREFORE, CALLED ON THE NUCLEAR WEAPON STATES PARTY TO THE TREATY TO RESUME TRILATERAL NEGOTIATIONS IN 1985 AND CALLED ON ALL THE NUCLEAR-WEAPON STATES TO PARTICIPATE IN THE URGENT NEGOTIATION AND CONCLUSION OF SUCH A TREATY AS A MATTER OF THE HIGHEST PRIORITY IN THE CONFERENCE ON DISARMAMENT.

15. AT THE SAME TIME, THE CONFERENCE NOTED THAT CERTAIN STATES PARTY TO THE TREATY, WHILE COMMITTED TO THE GOAL OF AN EFFECTIVELY VERIFIABLE COMPREHENSIVE NUCLEAR TEST BAN TREATY, CONSIDERED DEEP AND VERIFIABLE REDUCTIONS IN EXISTING ARSENALS OF NUCLEAR WEAPONS AS THE HIGHEST PRIORITY IN THE PROCESS OF PURSUING THE OBJECTIVE OF ARTICLE VI.

16. THE CONFERENCE ALSO NOTED THE STATEMENT OF THE USSR, AS ONE OF THE NUCLEAR WEAPON STATES PARTY TO THE TREATY, RECALLING ITS REPEATEDLY EXPRESSED READINESS TO PROCEED FORTHWITH TO NEGOTIATIONS, TRILATERAL AND MULTILATERAL, WITH THE AIM OF CONCLUDING A COMPREHENSIVE NUCLEAR TEST BAN TREATY AND THE SUBMISSION BY IT OF A DRAFT TREATY PROPOSAL TO THIS END.

## ARTICLE VII AND THE SECURITY OF NON-NUCLEAR-WEAPON STATES

1. THE CONFERENCE OBSERVES THE GROWING INTEREST IN UTILIZING THE PROVISIONS OF ARTICLE VII OF THE NON-PROLIFERATION TREATY, WHICH RECOGNIZES THE RIGHT OF ANY GROUP OF STATES TO CONCLUDE REGIONAL TREATIES IN ORDER TO ASSURE THE ABSENCE OF NUCLEAR WEAPONS IN THEIR RESPECTIVE TERRITORIES.

2. THE CONFERENCE CONSIDERS THAT THE ESTABLISHMENT OF NUCLEAR-WEAPON-FREE ZONES ON THE BASIS OF ARRANGEMENTS FREELY ARRIVED AT AMONG THE STATES OF THE REGION CONCERNED CONSTITUTES AN IMPORTANT DISARMAMENT MEASURE AND THEREFORE THE PROCESS OF ESTABLISHING SUCH ZONES IN DIFFERENT PARTS OF THE WORLD SHOULD BE ENCOURAGED WITH THE ULTIMATE OBJECTIVE OF ACHIEVING A WORLD ENTIRELY FREE OF NUCLEAR WEAPONS. IN THE PROCESS OF ESTABLISHING SUCH ZONES, THE CHARACTERISTICS OF EACH REGION SHOULD BE TAKEN INTO ACCOUNT.

3. THE CONFERENCE EMPHASIZES THE IMPORTANCE OF CONCLUDING NUCLEAR-WEAPON-FREE ZONE ARRANGEMENTS IN HARMONY WITH INTERNATIONALLY RECOGNIZED PRINCIPLES, AS STATED IN THE FINAL DOCUMENT OF THE FIRST SPECIAL SESSION OF THE UNITED NATIONS DEVOTED TO DISARMAMENT.

4. THE CONFERENCE HOLDS THE VIEW THAT, UNDER APPROPRIATE CONDITIONS, PROGRESS TOWARDS THE ESTABLISHMENT OF NUCLEAR-WEAPON-FREE ZONES WILL CREATE CONDITIONS MORE CONDUCIVE TO THE ESTABLISHMENT OF ZONES OF PEACE IN CERTAIN REGIONS OF THE WORLD.

5. THE CONFERENCE EXPRESSES ITS BELIEF THAT CONCRETE MEASURES OF NUCLEAR DISARMAMENT WOULD SIGNIFICANTLY CONTRIBUTE TO CREATING FAVOURABLE CONDITIONS FOR THE ESTABLISHMENT OF NUCLEAR-WEAPON-FREE ZONES.

6. THE CONFERENCE EXPRESSES ITS SATISFACTION AT THE CONTINUED SUCCESSFUL OPERATION OF THE TREATY FOR THE PROHIBITION OF NUCLEAR WEAPONS IN LATIN AMERICA (TREATY OF TLATELOLCO). IT REAFFIRMS THE REPEATED EXHORTATIONS OF THE GENERAL ASSEMBLY TO FRANCE, WHICH IS ALREADY A SIGNATORY OF ADDITIONAL PROTOCOL I, TO RATIFY IT, AND CALLS UPON THE LATIN AMERICAN STATES THAT ARE ELIGIBLE TO BECOME PARTIES TO THE TREATY TO DO SO. THE CONFERENCE WELCOMES THE SIGNATURE AND RATIFICATION OF ADDITIONAL PROTOCOL II TO THIS TREATY BY ALL NUCLEAR-WEAPON STATES.

7. THE CONFERENCE ALSO NOTES THE CONTINUED EXISTENCE OF THE ANTARCTIC TREATY.

8. THE CONFERENCE NOTES THE ENDORSEMENT OF THE SOUTH PACIFIC NUCLEAR FREE ZONE TREATY BY THE SOUTH-PACIFIC FORUM ON 6 AUGUST 1985 AT RAROTONGA AND WELCOMES THIS ACHIEVEMENT AS CONSISTENT WITH ARTICLE VII OF THE NON-PROLIFERATION TREATY. THE CONFERENCE ALSO TAKES NOTE OF THE DRAFT PROTOCOLS TO THE SOUTH PACIFIC NUCLEAR FREE ZONE TREATY AND FURTHER NOTES THAT AGREEMENT AT THE SOUTH PACIFIC FORUM THAT CONSULTATIONS ON THE PROTOCOLS SHOULD BE HELD BETWEEN MEMBERS OF THE FORUM AND THE NUCLEAR-WEAPON STATES ELIGIBLE TO SIGN THEM.

9. THE CONFERENCE TAKES NOTE OF THE EXISTING PROPOSALS AND THE ONGOING REGIONAL EFFORTS TO ACHIEVE NUCLEAR WEAPON-FREE ZONES IN DIFFERENT AREAS OF THE WORLD.

10. THE CONFERENCE RECOGNIZES THAT FOR THE MAXIMUM EFFECTIVENESS OF ANY TREATY ARRANGEMENTS FOR ESTABLISHING A NUCLEAR-WEAPON-FREE ZONE THE CO-OPERATION OF THE NUCLEAR WEAPON STATES IS NECESSARY. IN THIS CONNECTION, THE NUCLEAR-WEAPON STATES ARE INVITED TO ASSIST THE EFFORTS OF STATES TO CREATE NUCLEAR-WEAPON-FREE ZONES, AND TO ENTER INTO BINDING UNDERTAKINGS TO RESPECT STRICTLY THE STATUS OF SUCH A ZONE AND TO REFRAIN FROM THE USE OR THREAT OF USE OF NUCLEAR WEAPONS AGAINST THE STATES OF THE ZONE.

11. THE CONFERENCE WELCOMES THE CONSENSUS REACHED BY THE UNITED NATIONS GENERAL ASSEMBLY AT ITS THIRTY-FIFTH SESSION THAT THE ESTABLISHMENT OF A NUCLEAR-WEAPON-FREE ZONE IN THE REGION OF THE MIDDLE EAST WOULD GREATLY ENHANCE INTERNATIONAL PEACE AND SECURITY, AND URGES ALL PARTIES DIRECTLY CONCERNED TO CONSIDER SERIOUSLY TAKING THE PRACTICAL AND URGENT STEPS REQUIRED FOR THE IMPLEMENTATION OF THE PROPOSAL TO ESTABLISH A NUCLEAR-WEAPON-FREE ZONE IN THE REGION OF THE MIDDLE EAST.

12. THE CONFERENCE ALSO INVITES THE NUCLEAR-WEAPON STATES AND ALL OTHER STATES TO RENDER THEIR ASSISTANCE IN THE ESTABLISHMENT OF THE ZONE AND AT THE SAME TIME TO REFRAIN FROM ANY ACTION THAT RUNS COUNTER TO THE LETTER AND SPIRIT OF UNITED NATIONS GENERAL ASSEMBLY RESOLUTION 39/54.

13. THE CONFERENCE CONSIDERS THAT ACCEDING TO THE NON-PROLIFERATION TREATY AND ACCEPTANCE OF IAEA SAFEGUARDS BY ALL STATES IN THE REGION OF THE MIDDLE EAST WILL GREATLY FACILITATE THE CREATION OF A NUCLEAR-WEAPON-FREE ZONE IN THE REGION AND WILL ENHANCE THE CREDIBILITY OF THE TREATY.

14. THE CONFERENCE CONSIDERS THAT THE DEVELOPMENT OF A NUCLEAR WEAPON CAPABILITY BY SOUTH AFRICA AT ANY TIME FRUSTRATES THE IMPLEMENTATION OF THE DECLARATION ON THE DENUCLEARIZATION OF AFRICA AND THAT COLLABORATION WITH SOUTH AFRICA IN THIS AREA WOULD UNDERMINE THE CREDIBILITY AND THE STABILITY OF THE NON-PROLIFERATION TREATY REGIME. SOUTH AFRICA IS CALLED UPON TO SUBMIT ALL ITS NUCLEAR INSTALLATIONS AND FACILITIES TO IAEA SAFEGUARDS AND TO ACCEDE TO THE NON-PROLIFERATION TREATY. ALL STATES PARTIES DIRECTLY CONCERNED ARE URGED TO CONSIDER SERIOUSLY TAKING THE PRACTICAL AND URGENT STEPS REQUIRED FOR THE IMPLEMENTATION OF THE PROPOSAL TO ESTABLISH A NUCLEAR-WEAPON-FREE ZONE IN AFRICA. THE NUCLEAR-WEAPON STATES ARE INVITED TO ASSIST THE EFFORTS OF STATES TO CREATE A NUCLEAR-WEAPON-FREE ZONE IN AFRICA, AND TO ENTER INTO BINDING UNDERTAKINGS TO RESPECT STRICTLY THE STATUS OF SUCH A ZONE AND TO REFRAIN FROM THE USE OR THREAT OF USE OF NUCLEAR WEAPONS AGAINST THE STATES OF THE ZONE.

15. THE CONFERENCE CONSIDERS THAT THE MOST EFFECTIVE GUARANTEE AGAINST THE POSSIBLE USE OF NUCLEAR WEAPONS AND THE DANGER OF NUCLEAR WAR IS NUCLEAR DISARMAMENT AND THE COMPLETE ELIMINATION OF NUCLEAR WEAPONS. PENDING THE ACHIEVEMENT OF THIS GOAL ON A UNIVERSAL BASIS AND RECOGNIZING THE NEED FOR ALL STATES TO ENSURE THEIR INDEPENDENCE, TERRITORIAL INTEGRITY AND SOVEREIGNTY, THE CONFERENCE REAFFIRMS THE PARTICULAR IMPORTANCE OF ASSURING AND STRENGTHENING THE SECURITY OF NON-NUCLEAR-WEAPON STATES PARTIES WHICH HAVE RENOUNCED THE ACQUISITION OF NUCLEAR WEAPONS. THE CONFERENCE RECOGNIZES THAT DIFFERENT APPROACHES MAY BE REQUIRED TO STRENGTHEN THE SECURITY OF NON-NUCLEAR-WEAPON STATES PARTIES TO THE TREATY.

16. THE CONFERENCE UNDERLINES AGAIN THE IMPORTANCE OF ADHERENCE TO THE TREATY BY NON-NUCLEAR-WEAPON STATES AS THE BEST MEANS OF REASSURING ONE ANOTHER OF THEIR RENUNCIATION OF NUCLEAR WEAPONS AND AS ONE OF THE EFFECTIVE MEANS OF STRENGTHENING THEIR MUTUAL SECURITY.

17. THE CONFERENCE TAKES NOTE OF THE CONTINUED DETERMINATION OF THE DEPOSITARY STATES TO HONOUR THEIR STATEMENTS, WHICH WERE WELCOMED BY THE UNITED NATIONS SECURITY COUNCIL IN RESOLUTION 255 (1968), THAT, TO ENSURE THE SECURITY OF THE NON-NUCLEAR-WEAPON STATES PARTIES TO THE TREATY, THEY WILL PROVIDE OR SUPPORT IMMEDIATE ASSISTANCE, IN ACCORDANCE WITH THE CHARTER, TO ANY NON-NUCLEAR-WEAPON STATE PARTY TO THE TREATY WHICH IS A VICTIM OF AN ACT OR AN OBJECT OF A THREAT OF AGGRESSION IN WHICH NUCLEAR WEAPONS ARE USED.

18. THE CONFERENCE REITERATES ITS CONVICTION THAT, IN THE INTEREST OF PROMOTING THE OBJECTIVES OF THE TREATY, INCLUDING THE STRENGTHENING OF THE SECURITY OF NON-NUCLEAR WEAPON STATES PARTIES, ALL STATES, BOTH NUCLEAR-WEAPON AND NON-NUCLEAR-WEAPON STATES, SHOULD REFRAIN, IN ACCORDANCE WITH THE CHARTER OF THE UNITED NATIONS, FROM THE THREAT OR THE USE OF FORCE IN RELATIONS BETWEEN STATES, INVOLVING EITHER NUCLEAR OR NON-NUCLEAR WEAPONS.

19. THE CONFERENCE RECALLS THAT THE TENTH SPECIAL SESSION OF THE GENERAL ASSEMBLY IN PARAGRAPH 59 OF THE FINAL DOCUMENT TOOK NOTE OF THE DECLARATIONS MADE BY THE NUCLEAR-WEAPON STATES REGARDING THE ASSURANCE OF NON-NUCLEAR-WEAPON STATES AGAINST THE USE OR THREAT OF USE OF NUCLEAR WEAPONS AND URGED THEM TO PURSUE EFFORTS TO CONCLUDE, AS APPROPRIATE, EFFECTIVE ARRANGEMENTS TO ASSURE NON-NUCLEAR-WEAPON STATES AGAINST THE USE OR THREAT OF USE OF NUCLEAR WEAPONS.

20. BEING AWARE OF THE CONSULTATIONS AND NEGOTIATIONS ON EFFECTIVE INTERNATIONAL ARRANGEMENTS TO ASSURE NON-NUCLEAR WEAPON STATES AGAINST THE USE OR THREAT OF USE OF NUCLEAR WEAPONS, WHICH HAVE BEEN UNDER WAY IN THE CONFERENCE ON DISARMAMENT FOR SEVERAL YEARS, THE CONFERENCE REGRETS THAT

THE SEARCH FOR A COMMON APPROACH WHICH COULD BE INCLUDED IN AN INTERNATIONAL LEGALLY BINDING INSTRUMENT, HAS BEEN UNSUCCESSFUL. THE CONFERENCE TAKES NOTE OF THE REPEATEDLY EXPRESSED INTENTION OF THE CONFERENCE ON DISARMAMENT TO CONTINUE TO EXPLORE WAYS AND MEANS TO OVERCOME THE DIFFICULTIES ENCOUNTERED IN ITS WORK AND TO CARRY OUT NEGOTIATIONS ON THE QUESTION OF EFFECTIVE INTERNATIONAL ARRANGEMENTS TO ASSURE NON-NUCLEAR-WEAPON STATES AGAINST THE USE OR THREAT OF USE OF NUCLEAR WEAPONS. IN THIS CONNECTION, THE CONFERENCE CALLS UPON ALL STATES, PARTICULARLY THE NUCLEAR-WEAPON STATES, TO CONTINUE THE NEGOTIATIONS IN THE CONFERENCE ON DISARMAMENT DEVOTED TO THE SEARCH FOR A COMMON APPROACH ACCEPTABLE TO ALL, WHICH COULD BE INCLUDED IN AN INTERNATIONAL INSTRUMENT OF A LEGALLY BINDING CHARACTER.

### ARTICLE VIII

THE STATES PARTY TO THE TREATY PARTICIPATING IN THE CONFERENCE PROPOSE TO THE DEPOSITARY GOVERNMENTS THAT A FOURTH CONFERENCE TO REVIEW THE OPERATION OF THE TREATY BY CONVENED IN 1990.

THE CONFERENCE ACCORDINGLY INVITES STATES PARTY TO THE TREATY WHICH ARE MEMBERS OF THE UNITED NATIONS TO REQUEST THE SECRETARY-GENERAL OF THE UNITED NATIONS TO INCLUDE THE FOLLOWING ITEM IN THE PROVISIONAL AGENDA OF THE FORTY-THIRD SESSION OF THE GENERAL ASSEMBLY:

"IMPLEMENTATION OF THE CONCLUSIONS OF THE THIRD REVIEW CONFERENCE OF THE PARTIES TO THE TREATY ON THE NON-PROLIFERATION OF NUCLEAR WEAPONS AND ESTABLISHMENT OF A PREPARATORY COMMITTEE FOR THE FOURTH CONFERENCE."

### ARTICLE IX

THE CONFERENCE, HAVING EXPRESSED GREAT SATISFACTION THAT THE OVERWHELMING MAJORITY OF STATES HAVE ACCEDED TO THE TREATY ON THE NON-PROLIFERATION OF NUCLEAR WEAPONS AND HAVING RECOGNIZED THE URGENT NEED FOR FURTHER ENSURING THE UNIVERSALITY OF THE TREATY, APPEALS TO ALL STATES, PARTICULARLY THE NUCLEAR-WEAPON STATES AND OTHER STATES ADVANCED IN NUCLEAR TECHNOLOGY, WHICH HAVE NOT YET DONE SO, TO ADHERE TO THE TREATY AT THE EARLIEST POSSIBLE DATE.

December 19, 1985

# APPENDIX E

## NUCLEAR AND SPACE TALKS

| Elements | Soviet Counterproposal<br>October 1985 | New US Proposal<br>November 1985 |
|---|---|---|
| | START | |
| General Approach | 50% reduction in nuclear delivery vehicles, including over 1,100 US LRINF missiles, and tactical and carrier aircraft, but excluding some 2,000 comparable Soviet forces and some 300 Backfire bombers. | 50% reduction in various categories of comparable US/Soviet strategic forces (numbers of ballistic missile warheads, current level of Soviet throw-weight, and planned numbers of US ALCMs), leading to equality and increased stability at lower levels. |
| Weapons | 6,000 warheads for each side on delivery systems capable of reaching other side's territory, including ballistic missile RVs and all aircraft weapons. US weapons on tactical and carrier aircraft, P-II and GLCM would count, comparable Soviet weapons would not count. No more than 60 percent on one component -- ICBMs, SLBMs, or delivery aircraft. | Separate limits on ballistic missile warheads and ALCMs, to total 6,000 for each side. Other heavy bomber weapons limited indirectly by bomber limit. |
| Ballistic Missile RVs | Freedom-to-mix within 6,000/60 percent limits. | 4,500 on ICBMs and SLBMs for each side. |
| ICBM RVs | Maximum of 3,600 for each side. | Maximum of 3,000 for each side. |
| Strategic Nuclear Delivery Vehicles | 1,250 for USSR (ICBMs, SLBMs, and heavy bombers). 1,680 for US (ICBMs, SLBMs, heavy bombers, plus LRINF missiles and tactical aircraft in Europe and Asia and dual-capable aircraft on 14 carriers). Excludes some 2,000 comparable Soviet systems and some 300 Backfires. | Separate limits on ballistic missiles and heavy bombers, to total 1,600-1,800 for each side (ICBMs, SLBMs, and heavy bombers). |
| Ballistic Missiles | No sublimit, freedom-to-mix within SNDV limit. | 1,250 to 1,450 for each side. |

| Elements | Soviet Counterproposal<br>October 1985 | New US Proposal<br>November 1985 |
|---|---|---|
| Heavy Bombers | No sublimit, freedom-to-mix within SNDV limit. | 350 for each side. |
| Long-range Cruise Missiles | Ban all types of cruise missiles over 600 km range. | 1,500 ALCMs for each side contingent upon Soviet acceptance of RV and throw-weight limitations. Constraints on SLCMs not necessary, but remain prepared to consider Soviet proposal for stabilizing, equitable and effectively verifiable limits. |
| Throw-weight | No limitation in this category. | Equal limit for each side 50 percent below current Soviet ICBM/SLBM throw-weight. |
| Heavy ICBMs | No sublimit within SNDV limit. | Ban on new heavy ICBMs, ban on modernized SS-18. |
| Mobile ICBMs | No sublimit within SNDV limit. | Banned. |

### LRINF
(land based missiles and aircraft)

| | | |
|---|---|---|
| Global LRINF Warheads | Freeze, as of December 1, 1985, followed by cuts of US and USSR LRINF missiles in Europe. | Equal limits for both sides. |
| LRINF Warheads in Europe | Freeze at December 1 levels; after 18 months: zero P-II, 100-120 GLCM, SS-20s to match US/UK/FR; ultimately: US zero, SS-20s to match UK/FR. | 420 SS-20 warheads; 420-450 US (P-II and GLCM mix). |

| Elements | Soviet Counterproposal<br>October 1985 | New US Proposal<br>November 1985 |
|---|---|---|
| LRINF Missile Launchers | Freeze US and Soviet LRINF missiles in Europe as of December 1, 1985; after 18 months: zero P-II, 100-120 GLCM, SS-20s to match US/UK/FR; ultimately: US zero, SS-20s to match UK/FR. | Interim limit of 140 US LRINF missile launchers in Europe and Soviet SS-20 launchers in range of NATO Europe; zero ultimately. |
| Freedom-to-mix LRINF in Europe | Freeze mix as of December 1, 1985; after 18 months US GLCMs allowed (100-120) but P-II banned; ultimately US zero, SS-20s match UK/FR. Ban on deployments of nuclear weapons in countries where they do not exist. | Freedom to mix within the 140 launcher limit, system types deployed as of December 31, 1985; mix subject to discussion; US right to redistribute missiles among basing countries as decided by US and NATO. |
| SS-20s in Asia | Freeze on SS-20s in Asia in exchange for agreement to Soviet proposal limiting INF in Europe, and provided no change in the strategic situation in Asia. | Reductions in Asia (outside range of NATO Europe) proportional to those in Europe. |
| Shorter-Range Missiles | No provision. | Appropriate constraints on shorter-range INF systems. |
| LRINF Aircraft | No specific provision in interim INF proposal; US aircraft capable of reaching the USSR would count against US START total of 1,680 SNDVs. No limitations on comparable Soviet aircraft. | No specific provision; but, prepared to discuss. |

| Elements | Soviet Counterproposal<br>October 1985 | New US Proposal<br>November 1985 |
|---|---|---|
| | **Defense and Space** | |
| SDI | A ban on development (including scientific research), testing, and deployment of "space-strike arms", including anti-satellite weapons. | Reaffirm that SDI program will be conducted in accordance with ABM Treaty. Joint commitment to explore cooperative transition to strategic defense reliance. "Open laboratories" initiative to provide briefings on each other's strategic defense research programs and allowing visits to each side's facilities and laboratories. |

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# APPENDIX F

December 23, 1985

## The President's Unclassified Report on Soviet Noncompliance with Arms Control Agreements

In reporting to the Congress on February 7 of this year on Soviet noncompliance with arms control agreements, I stated that:

> "In order for arms control to have meaning and credibly contribute to national security and to global or regional stability, it is essential that all parties to agreements fully comply with them. Strict compliance with all provisions of arms control agreements is fundamental, and this Administration will not accept anything less. To do so would undermine the arms control process and damage the chances for establishing a more constructive U.S.-Soviet relationship."

I further stated that:

> "Soviet noncompliance is a serious matter. It calls into question important security benefits from arms control, and could create new security risks. It undermines the confidence essential to an effective arms control process in the future. With regard to the issues analyzed in the January 1984 report, the Soviet Union has thus far not provided satisfactory explanations nor undertaken corrective actions sufficient to alleviate our concerns. The United States Government has vigorously pressed, and will continue to press, these compliance issues with the Soviet Union through diplomatic channels."

The important role of treaty compliance for future arms control was recently recognized by the United Nations. On December 12, 1985, the General Assembly passed by a vote of 131-0 (with 16 abstentions) a resolution on arms control compliance which had been introduced by the United States and other co-sponsors. The resolution:

- -- urges all parties to arms limitation and disarmament agreements to comply with their provisions;
- -- calls upon those parties to consider the implications of noncompliance for international security and stability and for the prospects for further progress in the field of disarmament; and
- -- appeals to all U.N. members to support efforts to resolve noncompliance questions "with a view toward encouraging strict observance of the provisions subscribed to and maintaining or restoring the integrity of arms limitation or disarmament agreements."

At the request of the Congress, I have in the past two years provided three reports to the Congress on Soviet compliance issues. The first, forwarded in January 1984, reviewed seven compliance issues, concluding that the Soviet Union had, in fact, violated a number of important arms control commitments.

In September 1984 I provided, at the request of the Congress, a report on Soviet noncompliance prepared by the independent General Advisory Committee on Arms Control and Disarmament. That report concluded that over a 25-year span the Soviets had violated a substantial number of arms control commitments.

In February 1985, I submitted a report to the Congress updating the Administration's January 1984 report and reviewing 13 issues that could be treated in unclassified terms and an additional group of six issues treated on a classified basis. That report discussed the pattern of Soviet arms control violations, probable violations, or ambiguous activity in seventeen cases. The U.S. Government found seven Soviet violations, three probable violations, one likely and one potential violation. The Soviets were found to be in compliance in two other cases examined.

One of those issues, Yankee-Class submarine reconfiguration, is not addressed in the current report. While a submarine reconfigured to carry long-range cruise missiles constitutes a threat similar to that of the original SSBN, I reported in February that Soviet reconfiguration activities have not been in violation of the SALT I Interim Agreement. This issue, therefore, requires no further judgment in terms of compliance at present.

Public Law 99-145 requires the Administration to provide on an annual basis by December 1 of each year a classified and unclassified report to the Congress containing the findings of the President and any additional information necessary to keep the Congress informed on Soviet compliance with arms control agreements.

The current report responds to this Congressional requirement. It is the product of months of careful technical and legal analysis by all relevant agencies of the United States Government and represents the Administration's authoritative updated treatment of this important matter.

The current unclassified report examines one new issue and updates all of the issues studied in the classified report of February 1985, except the issue of Yankee-Class submarine reconfiguration. There are violations in nine cases. Of the nine cases involving violations, one SALT II issue — that of Soviet concealment of the association between missiles and their launchers -- is examined for the first time. The Soviet Union has now also violated its commitment to the SALT I Interim Agreement through the prohibited use of remaining facilities at former SS-7 ICBM sites. In addition, Soviet deployment of the SS-25 ICBM during 1985 constitutes a further violation of the SALT II prohibition on a second new type of ICBM. Several other issues involve potential, probable or likely violations.

The current unclassified report reaffirms the findings of the February 1985 classified report concerning ABM issues, making public two of them for the first time. It also reaffirms the February findings concerning SALT II issues involving violations, including one concerning strategic nuclear delivery vehicles, which has not previously been made public. In two SALT II issues with respect to which the Soviets were not judged to be in clear violation in the classified report of last February, the findings are altered or updated. These two issues are the SS-16 and an issue made public for the first time -- Backfire Bomber production rate.

The Administration's most recent studies support its conclusion that there is a pattern of Soviet noncompliance. As documented in this and previous reports, the Soviet Union has violated its legal obligation under or political commitment to the SALT I ABM Treaty and Interim Agreement, the SALT II agreement, the Limited Test Ban Treaty of 1963, the Biological and Toxin Weapons Convention, the Geneva Protocol on Chemical Weapons, and the Helsinki Final Act. In addition, the U.S.S.R. has likely violated provisions of the Threshold Test Ban Treaty.

While we remain concerned about Soviet violations of Basket I of the Helsinki Final Act and the Limited Test Ban Treaty, there is no unambiguous evidence of new 1985 Soviet violations of these two treaties. With regard to the Biological and Toxin Weapons Convention, or the Geneva Protocol on Chemical Weapons, there also is no unambiguous evidence of new 1985 Soviet lethal attacks that meets our strict standards of evidence. However, the Soviets clearly remain in violation of the Biological and Toxin Weapons Convention.

## THE SIGNIFICANCE OF SOVIET NONCOMPLIANCE

Through its noncompliance, the Soviet Union has made military gains in the areas of strategic offensive arms as well as chemical, biological and toxin weapons. If the yields of Soviet nuclear tests have been substantially above 150 kilotons, then Soviet testing would allow proportionately greater gains in nuclear weapons development than the U.S. could achieve. The possible extent of the Soviet Union's military gains by virtue of its noncompliance in the area of strategic defense also is of increasing importance and serious concern.

In a fundamental sense, all deliberate Soviet violations are equally important. As violations of legal obligations or political commitments, they cause grave concern regarding Soviet commitment to arms control, and they darken the atmosphere in which current negotiations are being conducted in Geneva and elsewhere.

In another sense, Soviet violations are not of equal importance. While some individual violations are of little apparent military significance in their own right, such violations can acquire importance if, left unaddressed, they are permitted to become precedents for future, more threatening violations. Moreover, some issues that individually have little military significance could conceivably become significant when taken in their aggregate.

### The Krasnoyarsk Radar

The radar under construction near Krasnoyarsk in Siberia is disturbing for both political and military reasons. Politically, the radar demonstrates that the Soviets are capable of violating arms control obligations and commitments even when they are negotiating with the United States or when they know we will detect a violation. The 1972 ABM Treaty prohibits the Soviets from siting an ABM radar, or siting and orienting a ballistic missile detection and tracking radar, as the Krasnoyarsk radar is sited and oriented.

Militarily, the Krasnoyarsk radar violation goes to the heart of the ABM Treaty. Large phased-array radars (LPARs) like that under construction near Krasnoyarsk were recognized during the ABM Treaty negotiations as the critical, long lead-time element of a nationwide ABM defense.

When considered as a part of a Soviet network of new LPARs, the Krasnoyarsk radar has the inherent potential to contribute to ABM radar coverage of a significant portion of the central U.S.S.R. Moreover, the Krasnoyarsk radar closes the remaining gap in Soviet ballistic missile detection and tracking coverage.

### ABM Territorial Defense and Other ABM Activities

The Krasnoyarsk radar appears even more menacing when considered in the context of other Soviet ABM-related activities. Together they cause concern that the Soviet Union may be preparing an ABM territorial defense. Some of these activities, such as permitted LPARs and the Moscow ABM deployment area, are consistent with the ABM Treaty. Others involve potential or probable Soviet violations or other ambiguous activity, including:

-- the apparent testing and development of components required for an ABM system which could be deployed to a site in months rather than years;

-- the probable concurrent testing of air defense components and ABM components;

-- the development of a modern air defense system, the SA-X-12, which may have some ABM capabilities; and

-- the demonstration of an ability to reload ABM launchers and to refire the interceptor missile in a period of time shorter than previously noted.

Soviet deployment of an ABM territorial defense contrary to the ABM Treaty would have profound implications for Western security and the vital East-West strategic balance. A unilateral Soviet territorial ABM capability acquired in violation of the ABM Treaty could erode our deterrent and leave doubts about its credibility. Such a capability might encourage the Soviets to take increased risks in crises, thus degrading crisis stability.

### SS-25

The SS-25, a clear and irreversible violation of the Soviet Union's SALT II commitment, also has important political and military implications. Testing and deployment of this missile violates a central provision of the SALT II Treaty, which was intended to limit the number of new ICBMs. The Treaty permits only one new type of ICBM for each Party. The Soviets have informed us that their one new type will be the SS-X-24, which is now undergoing testing, and have falsely asserted that the SS-25 is a permitted modernization of the silo-based SS-13 ICBM.

Under the pretext of permitted modernization, the Soviets, since the last compliance report, have deployed a prohibited second new type of missile, the SS-25, which is mobile and could be made more lethal. The SS-25 also could be modified to carry more than a single warhead. Most worrisome is the technical argument by which the Soviets sought to justify the SS-25, for it might be applied to additional prohibited new types of ICBMs in the future.

## Telemetry Encryption and Concealment of Missile/Launcher Association

Two other Soviet violations impede our ability to verify the Soviet Union's compliance with its political commitments. Soviet use of encryption impedes U.S. verification of Soviet compliance and thus contravenes the provision of the SALT II Treaty which prohibits use of deliberate concealment measures which impede verification of compliance by national technical means. A new finding of this report is that current Soviet activities violate the provision of the Treaty which prohibits use of deliberate concealment measures associated with testing, including those measures aimed at concealing the association between ICBMs and launchers during testing. These deliberate Soviet concealment activities impede our ability to know whether a type of missile is in compliance with SALT II requirements. They could also make it more difficult for the United States to assess accurately the critical parameters of any future missile.

Since the SALT I agreement in 1972, Soviet encryption and concealment activities have become more extensive and disturbing. These activities, Soviet responses on these issues, and Soviet failure to take the corrective actions which the United States has repeatedly requested, are indicative of a Soviet attitude contrary to the fundamentals of sound arms control agreements. Soviet encryption and concealment activities present special obstacles to maintaining existing arms control agreements, undermine the political confidence necessary for concluding new treaties, and underscore the necessity that any new agreement be effectively verifiable. Soviet noncompliance, as documented in current and past Administration reports and exemplified by the encryption and concealment issues, has made verification and compliance pacing elements of arms control today.

## Chemical, Biological and Toxin Weapons

The Soviet Union's violations of its legal obligations under the Biological and Toxin Weapons Convention and the Geneva Protocol have important political and military implications. The Soviets had a program of biological and toxin weapons before they signed the multilateral Treaty. Upon signing the Treaty, the Soviets not only did not stop their illegal program but they expanded facilities and were instrumental in the use of prohibited agents.

The Soviet Union has a prohibited offensive biological warfare capability which we do not have and against which we have no defense. This capability may include advanced biological agents about which we have little knowledge. Evidence suggests that the Soviets are expanding their chemical and toxin warfare capabilities in a manner that has no parallel in NATO's retaliatory or defensive programs. Even though there has been no unambiguous evidence of lethal attacks during 1985, previous activities have provided testing, development and operational experience.

## Nuclear Testing

With respect to the Threshold Test Ban Treaty, Soviet testing at yields above the 150 kiloton limit would allow development of advanced nuclear weapons with proportionately higher yields than the yields of weapons that the U.S. could develop under the Treaty. The U.S. Government judges that Soviet test activities constitute likely violations of the 150 kiloton limit.

## Other Issues

Military significance is evidently not necessarily the determining factor in Soviet decisions or actions which violate their arms control commitments. The Soviet Union has also violated or probably violated arms control obligations and commitments from which at present it appears to reap little military gain. The following cases are relevant in this regard:

— the use of remaining facilities at former SS-7 ICBM sites since the February 1985 compliance report (SALT I Interim Agreement);

-- exceeding the strategic nuclear delivery vehicle limits (SALT II);

-- probable deployment of the SS-16 (SALT II); and

— underground nuclear test venting (Limited Test Ban Treaty).

The 1981 Soviet violation of the military exercise notification provisions of the Helsinki Final Act involved an action contrary to the confidence building measures included in that agreement.

Soviet deployments of Backfire Bombers to Arctic staging bases are inconsistent with the Soviet Union's political commitment to the SALT II Treaty. In addition, while there are ambiguities concerning the data, there is evidence that the production rate of the Backfire Bomber was constant at slightly more than 30 per year until 1984, and slightly less than 30 per year since then. These Soviet Backfire Bomber activities will continue to be monitored and assessed.

## THE SOVIET RESPONSE

At the same time as the Administration has reported its concerns and findings to the Congress, the United States has had extensive exchanges with the Soviet Union on Soviet noncompliance in the Standing Consultative Commission (SCC), where SALT-related issues (including ABM issues) are discussed, and through other appropriate diplomatic channels. I expressed my personal concerns directly to General Secretary Gorbachev during my recent meeting with him in Geneva.

All of the violations, probable violations and ambiguous situations included in this report and previously reported on have been raised with the Soviets, except certain sensitive issues. The Soviet Union has thus far not provided explanations sufficient to alleviate our concerns on these issues, nor has the Soviet Union taken actions needed to correct existing violations. Instead, they have continued to assert that they are in complete compliance with their arms control obligations and commitments.

## US POLICY

In contrast with the Soviet Union, the United States has fully observed its arms control obligations and commitments, including those under the SALT I and SALT II agreements. As I stated in my message to the Congress on June 10 of this year concerning U.S. interim restraint policy:

> "In 1982, on the eve of the Strategic Arms Reductions Talks (START), I decided that the United States would not undercut the expired SALT I agreement or the unratified SALT II agreement as long as the Soviet Union exercised equal restraint. Despite my serious reservations about the inequities of the SALT I agreement and the serious flaws of the SALT II agreement, I took this action in order to foster an atmosphere of mutual restraint conducive to serious negotiation as we entered START.
>
> "Since then, the United States has not taken any actions which would undercut existing arms control agreements. The United States has fully kept its part of the bargain. However, the Soviets have not. They have failed to comply with several provisions of SALT II, and we have serious concerns regarding their compliance with the provisions of other accords.
>
> "The pattern of Soviet violations, if left uncorrected, undercuts the integrity and viability of arms control as an instrument to assist in ensuring a secure and stable future world. The United

> States will continue to pursue vigorously with the Soviet Union the resolution of our concerns over Soviet noncompliance. We cannot impose upon ourselves a double standard that amounts to unilateral treaty compliance."

On June 10, I invited the Soviet Union to join the United States in an interim framework of truly mutual restraint on strategic offensive arms and to pursue with renewed vigor our top priority of achieving deep reductions in the size of existing nuclear arsenals in the ongoing negotiations in Geneva. I noted that the U.S. cannot establish such a framework alone and that it would require the Soviet Union to take positive, concrete steps to correct its noncompliance, to resolve our other compliance concerns, to reverse its unparalleled and unwarranted military buildup, and actively to pursue arms reduction agreements in the Geneva negotiations.

In going the extra mile, I have made clear that as an integral part of this policy, we will also take those steps required to assure our national security and that of our Allies that were made necessary by Soviet noncompliance. Thus, as I indicated to the Congress on June 10, "appropriate and proportionate responses to Soviet noncompliance are called for to ensure our security, to provide incentives to the Soviets to correct their noncompliance, and to make it clear to Moscow that violations of arms control obligations entail real costs."

As we monitor Soviet actions for evidence of the positive, concrete steps needed on their part to correct these activities, I have directed the Department of Defense to conduct a comprehensive assessment aimed at identifying specific actions that the United States could take to augment as necessary the U.S. strategic modernization program as a proportionate response to, and as a hedge against the military consequences of those Soviet violations of existing arms control agreements which the Soviets fail to correct. We will carefully study this report as soon as it has been completed.

As we press for corrective Soviet actions and while keeping open all programmatic options for handling future milestones as new U.S. strategic systems are deployed, we will continue to assess the overall situation in light of Soviet actions correcting their noncompliance, reversing their military build-up, and promoting progress in Geneva.

I look forward to continued close consultation with the Congress as we seek to make progress in resolving compliance issues and in negotiating sound arms control agreements.

The findings on Soviet noncompliance with arms control agreements follow.

## THE FINDINGS

### Anti-Ballistic Missile (ABM) Treaty

#### Treaty Status

The 1972 ABM Treaty and its Protocol ban deployment of ABM systems except that each party is permitted to deploy one ABM system around the national capital area or, alternatively, at a single ICBM deployment area. The ABM Treaty is in force and is of indefinite duration. Soviet actions not in accord with the ABM Treaty are, therefore, violations of a legal obligation.

#### 1. The Krasnoyarsk Radar

o Obligation: To preclude creation of a base for territorial ABM defense, the ABM Treaty provides that radars for early warning of ballistic missile attack may be deployed only at locations along the periphery of the national territory of each party and that they be oriented outward. The Treaty permits deployment (without regard to location or orientation) of large phased-array radars for purposes of tracking objects in outer space or for use as national technical means of verification of compliance with arms control agreements.

o Issue: The January 1984 and February 1985 reports examined the issue of whether the Krasnoyarsk radar meets the provisions of the ABM Treaty governing phased-array radars. This report reexamines this issue.

o Finding: The US Government reaffirms the conclusion in the February 1985 report that the new large phased-array radar under construction at Krasnoyarsk constitutes a violation of legal obligations under the Anti-Ballistic Missile Treaty of 1972 in that in its associated siting, orientation, and capability, it is prohibited by this Treaty. Continuing construction and the absence of credible alternative explanations have reinforced our assessment of its purpose. Despite US requests, no corrective action has been taken. This and other ABM-related Soviet activities suggest that the USSR may be preparing an ABM defense of its national territory.

2. Mobility of ABM System Components

o Obligation: The ABM Treaty prohibits the development, testing or deployment of mobile land-based ABM systems or components.

o Issue: The February 1985 report examined whether the Soviet Union has developed a mobile land-based ABM system, or components for such a system, in violation of its legal obligation under the ABM Treaty. This report reexamines this issue.

o Finding: The US Government judges that the evidence on Soviet actions with respect to ABM component mobility is ambiguous, but that the USSR's development and testing of components of an ABM system, which apparently are designed to be deployable at sites requiring relatively limited site preparation, represent a potential violation of its legal obligation under the ABM Treaty. This and other ABM-related Soviet activities suggest that the USSR may be preparing an ABM defense of its national territory.

3. Concurrent Testing of ABM and Air Defense Components

o Obligation: The ABM Treaty and its Protocol limit the Parties to one ABM deployment area. In addition to the ABM systems and components at that one deployment area, the Parties may have ABM systems and components for development and testing purposes so long as they are located at agreed test ranges. The Treaty also prohibits giving components, other than ABM system components, the capability "to counter strategic ballistic missiles or their elements in flight trajectory" and prohibits the Parties from testing them in "an ABM mode." The Parties agreed that the concurrent testing of SAM and ABM system components is prohibited.

o Issue: The February 1985 compliance report examined whether the Soviet Union has concurrently tested SAM and ABM system components in violation of its legal obligation since 1978 not to do so. It was the purpose of that obligation to further constrain testing of air defense systems in an ABM mode. This report reexamines this issue.

o Finding: The US Government reaffirms the judgment made in the February 1985 Report that the evidence of Soviet actions with respect to concurrent operations is insufficient fully to assess compliance with Soviet obligations under the ABM Treaty. However, the Soviet Union has conducted tests that have involved air defense radars in ABM-related activities. The large number, and consistency over time, of incidents of concurrent operation of ABM and SAM components, plus Soviet failure to accommodate fully US concerns, indicate the USSR probably has violated the prohibition on testing SAM components in an ABM mode. In several cases this may be highly probable. This and other ABM-related activities suggest the USSR may be preparing an ABM defense of its national territory.

4. ABM Capability of Modern SAM Systems

o Obligation: Under the ABM Treaty, each party undertakes not to give non-ABM interceptor missiles, launchers or radars "capabilities to counter strategic ballistic missiles or their elements in flight trajectory, and not to test them in an ABM mode ..."

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o Issue: The February 1985 classified report examined whether the Soviet Union has tested a SAM system or component in an ABM mode or given it the capability to counter strategic ballistic missiles or their elements in flight trajectory in violation of their legal obligation under the ABM Treaty. This report reexamines this issue.

o Finding: The US Government reaffirms the judgment made in the February 1985 report that the evidence of Soviet actions with respect to SAM upgrade is insufficient to assess compliance with the Soviet Union's obligations under the ABM Treaty. However, this and other ABM-related Soviet activities suggest that the USSR may be preparing an ABM defense of its national territory.

### 5. Rapid Reload of ABM Launchers

o Obligation: The ABM Treaty limits to 100 the number of deployed ABM interceptor launchers and deployed interceptor missiles. It does not limit the number of interceptor missiles that can be built and stockpiled. The Treaty prohibits the development, testing or deployment of "automatic or semi-automatic or other similar systems for rapid reload" of the permitted launchers.

o Issue: The February 1985 classified report examined whether the Soviet Union has developed, tested or deployed automatic, semi-automatic, or other similar systems for rapid reload of ABM launchers in violation of its legal obligation under the ABM Treaty. This report reexamines this issue.

o Finding: The US Government judges, on the basis of the evidence available, that the USSR's actions with respect to the rapid reload of ABM launchers constitute an ambiguous situation as concerns its legal obligations under the ABM Treaty not to develop systems for rapid reload. The Soviet Union's reload capabilities are a serious concern. These and other ABM-related Soviet activities suggest that the USSR may be preparing an ABM defense of its national territory.

### 6. ABM Territorial Defense

o Obligation: The ABM Treaty allows each party a single operational site, explicitly permits modernization and replacement of ABM systems or their components, and explicitly recognizes the existence of ABM test ranges for the development and testing of ABM components. The ABM Treaty prohibits, however, the deployment of an ABM system for defense of the national territory of the parties and prohibits the parties from providing a base for such a defense.

o Issue: The February 1985 report examined whether the Soviets have deployed an ABM system for the defense of their territory or provided a base for such a defense. This report reexamines this issue.

o Finding: The US Government judges that the aggregate of the Soviet Union's ABM and ABM-related actions (e.g., radar construction, concurrent testing, SAM upgrade, ABM rapid reload and ABM mobility) suggests that the USSR may be preparing an ABM defense of its national territory.

## SALT II Treaty

### Treaty Status

SALT II was signed in June 1979 and has not been ratified. In 1981 the United States made clear to the Soviet Union its intention not to ratify the SALT II Treaty. Prior to this clarification of our position in 1981, both nations were obligated under customary international law not to take actions which would defeat the object and purpose of the signed, but unratified, Treaty. Such Soviet actions prior to 1981 are violations of legal obligations. Since 1981, the United States has observed a political commitment to refrain from actions that undercut the SALT II Treaty so long as the Soviet Union does likewise. The Soviets have told us they also would abide by these provisions. Soviet actions inconsistent with this commitment are violations of their political commitment with respect to the SALT II Treaty.

1. The SS-25 ICBM

o Obligation: In an attempt to constrain the modernization and the proliferation of new, more capable types of ICBMs, the provisions of SALT II permit each side to "flight test and deploy" just one new type of "light" ICBM. A new type is defined as one that differs from an existing type by more than 5 percent in length, largest diameter, launch-weight or throw-weight or differs in number of stages or propellant type. In addition, it was agreed that no ICBM of an existing type with a post-boost vehicle and a single reentry vehicle would be flight-tested or deployed whose reentry vehicle weight is less than 50 percent of the throw-weight of that ICBM. This latter provision was intended to prohibit the possibility that single warhead ICBMs could quickly be converted to MIRVed systems.

o Issues: The January 1984 and February 1985 reports examined the evidence: whether the Soviets have tested or deployed a second new type of ICBM (the SS-25) which is prohibited; whether the reentry vehicle (RV) on that missile, if it is not a new type, is in compliance with the provision that for existing types of single RV missiles, the weight of the RV be equal to at least 50 percent of total throw-weight; and whether encryption of SS-25 flight test telemetry impedes verification. This report reexamines these issues.

o Findings:

a. Second New Type -- Testing and Deployment: The US Government judges, based on convincing evidence about the SS-25, that the throw-weight of the Soviet SS-25 ICBM exceeds by more than five percent the throw-weight of the Soviet SS-13 ICBM and cannot therefore be considered a permitted modernization of the SS-13 as the Soviets claim. The SS-25 is a prohibited second "new type" of ICBM and its testing, in addition to the testing of the SS-X-24 ICBM, thereby is a violation of the Soviet Union's political commitment to observe the "new type" provision of the SALT II Treaty. The deployment of this missile during 1985 constitutes a further violation of the SALT II prohibition on a second "new type" of ICBM.

b. RV-to-Throw-weight Ratio: The US Government reaffirms the conclusion of the January 1984 report regarding the SS-25 RV-to-throw-weight ratio. That is, if we were to accept the Soviet argument that the SS-25 is not a prohibited "new type" of ICBM, it would be a violation of their political commitment to observe the SALT II provision which prohibits the testing of such an existing ICBM with a single reentry vehicle whose weight is less than 50 percent of the throw-weight of the ICBM.

c. Encryption: The US Government reaffirms its judgment made in the January 1984 report regarding telemetry encryption during tests of the SS-25. Encryption during tests of this missile is illustrative of the deliberate impeding of verification of compliance in violation of the USSR's political commitment.

Despite US requests for explanations and corrective actions with regard to the SS-25 ICBM-related activities, Soviet actions continue unchanged, and the Soviet Union has proceeded to deployment of this missile.

2. Strategic Nuclear Delivery Vehicle Limits

o Obligation: The Soviet Union's political commitment to abide by SALT II is interpreted by the US Government as including an obligation not to increase the number of strategic nuclear delivery vehicles (SNDVs) in its arsenal. The Soviet Union had 2,504 SNDVs when it signed SALT II.

o Issue: The February 1985 classified report examined the issue of whether the Soviet Union has abided by its commitment not to exceed the level of 2,504 SNDVs. This report reexamines this issue.

o Finding: The US Government interprets the Soviet commitment to abide by SALT II as including the existence of a cap on SNDVs -- at a level of 2,504 existing at the time SALT II was signed. The Soviet Union has deployed SNDVs above the 2,504 cap in violation of its political commitment under SALT II. Such activity is indicative of a Soviet policy inconsistent with this political commitment.

### 3. SS-16 Deployment

o Obligation: The Soviet Union agreed in SALT II not to produce, test or deploy ICBMs of the SS-16 type and, in particular, not to produce the SS-16 third stage or the reentry vehicle of that missile.

o Issue: The January 1984 and February 1985 reports examined the evidence regarding whether the Soviets have deployed the SS-16 ICBM in spite of the ban on its deployment. This report reexamines this issue

o Finding: The President's February 1985 Report to Congress which noted that the evidence is somewhat ambiguous and we cannot reach a definitive conclusion, found the activities at Plesetsk to be a probable violation of the USSR's legal obligation and political commitment under SALT II. Soviet activity in the past year at Plesetsk seems to indicate the probable removal of SS-16 equipment and introduction of equipment associated with a different ICBM.

### 4. Backfire Bomber Intercontinental Operating Capability

o Obligation: At the signing of SALT II, the USSR gave the US assurances about the BACKFIRE bomber's intercontinental operating capability. The Soviet statement of June 16, 1979, read, in pertinent part, as follows:

> The Soviet side informs the US side that the Soviet "Tu-22M" airplane, called 'BACKFIRE' in the USA, is a medium-range bomber, and that it does not intend to give this airplane the capability of operating at intercontinental distances. In this connection, the Soviet side states that it will not increase the radius of action of this airplane in such a way as to enable it to strike targets on the territory of the USA. Nor does it intend to give it such a capability in any other manner, including by in-flight refueling ...

This unilateral statement is an integral part of the SALT II agreement and the US considers it to be incorporated in the Soviet Union's political commitment to abide by SALT II.

o Issue: The February 1985 classified report addressed the issue of whether temporary deployments of BACKFIRE bombers to Arctic bases constitute actions inconsistent with Brezhnev's June 16, 1979, statement not to give the BACKFIRE an increased radius of action and the capability of operating at intercontinental distances. This report reexamines this issue.

o Finding: The US Government judges that the temporary deployment of BACKFIREs to Arctic bases is cause for concern and continued careful monitoring. By such temporary deployment of BACKFIREs, the Soviet Union acted in a manner inconsistent with its political commitment in the June 1979 BACKFIRE statement not to give Backfire the capability to strike targets on the territory of the United States.

### 5. Backfire Bomber Production Rate

o Obligation: At the signing of SALT II, the USSR gave the US assurances about the Backfire bomber's production rate. The Soviet statement read, in pertinent part, as follows: "... the Soviet side states that it will not increase the production rate of this airplane as compared to the present rate." Soviet President Brezhnev, according to Secretary Vance's SALT II transmittal letter to the Senate, "confirmed that the Soviet BACKFIRE production rate would not exceed thirty per year." President Carter stated that the United States enters into the SALT II Agreement on the basis of the commitments contained in the Soviet statement and that it considers the carrying out of these commitments to be essential to the obligations under the Treaty. The US considers the Soviet unilateral statement to be an integral part of the SALT II Agreement and, as such, to be incorporated in the Soviet Union's political commitment to abide by SALT II.

o Issue: The February 1985 report examined the question of whether the Soviet Union has produced more than 30 BACKFIREs per year and increased the production rate since signing SALT II. This report reexamines this issue.

o Finding: The US Government judges that the Soviet Union is obligated to produce no more than 30 BACKFIRE bomber aircraft per year. There are ambiguities concerning the data. However, there is evidence that the Soviet BACKFIRE production rate was constant at slightly more than 30 per year until 1984, and decreased since that time to slightly below 30 per year.

6. Encryption of Ballistic Missile Telemetry

o Obligation: Provisions of SALT II ban deliberate concealment measures that impede verification by national technical means. The Treaty permits each party to use various methods of transmitting telemetric information during testing, including encryption, but bans deliberate denial of telemetry, such as through encryption, whenever such denial impedes verification.

o Issue: The January 1984 compliance report examined whether the Soviet Union has engaged in encryption of missile test telemetry (radio signals) so as to impede verification. This issue was reexamined in the February 1985 compliance report and is examined again in this report.

o Finding: The US Government reaffirms the conclusion in the February 1985 report that Soviet encryption practices constitute a violation of a legal obligation under SALT II prior to 1981 and a violation of their political commitment since 1982. The nature and extent of such encryption of telemetry on new ballistic missiles, despite US requests for corrective action, continues to be an example of deliberately impeding verification of compliance in violation of this Soviet political commitment.

7. Concealment of Missile/Launcher Association

o Obligation: Article XV of the SALT II Treaty prohibits "deliberate concealment measures which impede verification by national technical means of compliance with the provisions of this Treaty". This obligation is further clarified in a Common Understanding that states that Article XV applies to all provisions of the Treaty and "includes the obligation not to use deliberate concealment measures associated with testing, including those measures aimed at concealing the association between ICBMs and launchers during testing".

o Issue: This report examines for the first time the issue of whether the Soviets have concealed the association between an ICBM and its launcher during testing in violation of their obligation not to use deliberate concealment measures which impede verification.

o Finding: The US Government judges Soviet activities related to the SS-25 to be a violation of the Soviet Union's political commitment to abide by the SALT II Treaty provision prohibiting concealment of the association between a missile and its launcher during testing.

## SALT I Interim Agreement

### Treaty Status

The SALT I Interim Agreement entered into force for the United States and the Soviet Union in 1972. Dismantling procedures implementing the Interim Agreement were concluded in 1974. The Interim Agreement, by its own terms, was of limited duration and expired as a legally binding document in 1977. The applicability of the Interim Agreement to the actions of both parties has, however, been extended by the parties by a series of mutual political commitments, including the President's May 31, 1982 statement that the United States would refrain from actions which would undercut existing strategic arms agreements so long as the Soviet Union shows equal restraint. The Soviets have told us they would abide by the SALT I Interim Agreement and SALT II. Any actions by the USSR inconsistent with this commitment are violations of its political commitment with respect to the Interim Agreement and its implementing procedures.

### Use of "Remaining Facilities" at Former SS-7 Sites

o Obligation: The SALT I Interim Agreement and its procedures prohibit the Parties from using facilities remaining at dismantled or destroyed ICBM sites for storage, support, or launch of ICBMs. Any Soviet actions inconsistent with this commitment are violations of a political commitment with respect to the Interim Agreement and its implementing procedures.

o Issue: The February 1985 report examined whether the USSR has violated the SALT I Interim Agreement prohibition against using facilities remaining at dismantled former SS-7 ICBM sites for the storage, support or launch of SS-25 ICBMs. This report reexamines this issue.

o Finding: The US Government judges that Soviet use of former SS-7 ICBM facilities in support of the deployment and operation of the SS-25 mobile ICBMs is in violation of the SALT I Interim Agreement. Should the Soviets use "remaining facilities" in the future at other former SS-7 sites where the SS-25 is now in the process of being deployed, such use will also constitute Soviet violation of its political commitment under the SALT I Interim Agreement.

## Biological Weapons Convention and 1925 Geneva Protocol

### Chemical, Biological, and Toxin Weapons

o Treaty Status: The 1972 Biological and Toxin Weapons Convention (the BWC) and the 1925 Geneva Protocol are multilateral treaties to which both the United States and the Soviet Union are parties. Soviet actions not in accord with these treaties and customary international law relating to the 1925 Geneva Protocol are violations of legal obligations.

o Obligations: The BWC bans the development, production, stockpiling or possession, and transfer of microbial or other biological agents or toxins except for a small quantity for prophylactic, protective or other peaceful purposes. It also bans weapons, equipment and means of delivery of agents or toxins. The 1925 Geneva Protocol and related rules of customary international law prohibit the first use in war of asphyxiating, poisonous or other gases and of all analogous liquids, materials or devices and prohibits use of bacteriological methods of warfare.

o Issues: The January 1984 and February 1985 reports examined whether the Soviets are in violation of provisions that ban the development, production, transfer, possession and use of biological and toxin weapons and whether they have been responsible for the use of lethal chemicals. This report reexamines this issue.

o Finding: The US Government judges that ongoing Soviet activities confirm and strengthen the conclusion of the January 1984 and February 1985 reports that the Soviet Union has maintained an offensive biological warfare program and capability in violation of its legal obligation under the Biological and Toxin Weapons Convention of 1972.

Allegations concerning the use of lethal chemicals or toxins in Kampuchea, Laos, or Afghanistan have subsided in 1985. However, there is no basis for amending the February 1985 conclusion that, prior to this time, the Soviet Union has been involved in the production, transfer, and use of trichothecene mycotoxins for hostile purposes in Laos, Kampuchea, and Afghanistan in violation of its legal obligation under international law as codified in the Geneva Protocol of 1925 and the Biological and Toxin Weapons Convention of 1972.

## Threshold Test Ban Treaty

### Nuclear Testing and the 150 Kiloton Limit

o Treaty Status. The Threshold Test Ban Treaty (TTBT) was signed in 1974. The Treaty has not been ratified but neither party has indicated an intention not to ratify. Therefore, both Parties are subject to the obligation under customary international law to refrain from acts that would defeat the object and purpose of the TTBT. Soviet actions that would defeat the object and purpose of the TTBT are therefore violations of their legal obligations. The United States is seeking to negotiate improved verification measures for the Treaty. Both Parties have separately stated they would observe the 150 kiloton threshold of the TTBT.

o Obligation: The Treaty prohibits any underground nuclear weapon test having a yield exceeding 150 kilotons at any place under the jurisdiction or control of the Parties beginning March 31, 1976. In view of the technical uncertainties associated with estimating the precise yield of nuclear weapon tests, the sides agreed that one or two slight, unintended breaches per year would not be considered a violation.

o Issue: The January 1984 and February 1985 reports examined whether the Soviets have conducted nuclear tests in excess of 150 kilotons. This report reexamines this issue.

o Finding:

While ambiguities in the pattern of Soviet testing and verification uncertainties continued in 1985, the US Government reaffirms the February 1985 finding that Soviet nuclear testing activities for a number of tests constitute a likely violation of legal obligations under the Threshold Test Ban Treaty of 1974, which banned underground nuclear tests with yields exceeding 150 kilotons. These Soviet actions continued despite US requests for corrective measures.

### Limited Test Ban Treaty

#### Underground Nuclear Test Venting

o Treaty Status: The Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water (Limited Test Ban Treaty) (LTBT)) is a multilateral treaty that entered into force for the United States and the Soviet Union in 1963. Soviet actions not in accord with this treaty are violations of a legal obligation.

o Obligations: The LTBT specifically prohibits nuclear explosions in the atmosphere, in outer space and under water. It also prohibits nuclear explosions in any other environment "if such explosions cause radioactive debris to be present outside the territorial limits of the State under whose jurisdiction or control such explosion is conducted".

o Issue: The February 1985 report examined whether the USSR's underground nuclear tests have caused radioactive debris to be present outside of its territorial limits. This report reexamines this issue.

o Finding: The US Government reaffirms the judgment made in the February 1985 Report that the Soviet Union's underground nuclear test practices resulted in the venting of radioactive matter on numerous occasions and caused radioactive matter to be present outside the Soviet Union's territorial limits in violation of its legal obligation under the Limited Test Ban Treaty. The Soviet Union failed to take the precautions necessary to minimize the contamination of man's environment by radioactive substances despite numerous US demarches and requests for corrective action.

### Helsinki Final Act

#### Helsinki Final Act Notification of Military Exercises

o Legal Status: The Final Act of the Conference on Security and Cooperation in Europe was signed in Helsinki in 1975. This document represents a political commitment and was signed by the United States and the Soviet Union, along with many other States. Soviet actions not in accord with that document are violations of their political commitment.

o Obligation: All signatory States of the Helsinki Final Act are committed to give prior notification of, and other details concerning, major military maneuvers, defined as those involving more than 25,000 troops.

o Issue: The January 1984 and February 1985 reports examined whether notification of the Soviet military exercise "Zapad-81" was inadequate and therefore a violation of the Soviet Union's political commitment under the Helsinki Final Act. This report reexamines this issue.

o Finding: The US Government previously judged and continues to find that the Soviet Union in 1981 violated its political commitment to observe provisions of Basket I of the Helsinki Final Act by not providing prior notification of exercise "ZAPAD-81". While the USSR has generally taken an approach to the confidence-building measures of the Final Act which minimizes the information it provides, Soviet compliance with the exercise-notification provisions was improved in 1983. In 1984 the Soviets returned to a minimalist approach providing only the bare information required under the Final Act. The Soviet Union continued this approach during 1985.